This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at http://books.google.com/

Godfrey Lowell CABOT SCIENCE LIBRARY
of the Harvard College Library

This book is
FRAGILE
and circulates only with permission.
Please handle with care
and consult a staff member
before photocopying.

Thanks for your help in preserving
Harvard's library collections.

Eng

SOME INFORMATION

CONCERNING

GAS LIGHTS,

BY

THOMAS COOPER, ESQ.

PHILADELPHIA:

PUBLISHED BY JOHN CONRAD & CO.

J. Maxwell, printer.

1816.

Eng 2618.16

HARVARD COLLEGE
APR 14 1919
LIBRARY

Treadwell fund

PREFACE.

THE general adoption of the plan of lighting streets, manufactories, warehouses, and shops in London, by means of the inflammable air which is expelled from coal by distillation, has excited so much inquiry and conversation, that I have deemed it a fit opportunity to publish some information on a subject which is not yet well understood among us. No gas-light system has been yet adopted in America, and therefore I cannot give any result of my own experience on a large scale, although I have been in the habit, during four years past of exhibiting and burning the inflammable gas from coal and from wood, before my chymical students, as a part of the lecture on the various methods of procuring the carburetted hydrogen gas; all of which were shown, the lights they respectively afforded compared, and their uses explained.

I believe sir James Lowther, and Dr. James Clayton were the first persons who collected, and burned the gas from coal. The experiments of Dr. Clayton were made about the year 1739. The subject was pursued by Dr. Watson, afterwards bishop of Landaff, in 1767; afterwards in 1792 by Mr. Murdock at Birmingham and Manchester; and in 1803 and 1804 by Mr. Winsor in London. I was informed at Northumberland in Pennsylvania, by a Mr. Henfrey, I think about the year 1800, that he was going to Baltimore to exhibit a new method of lighting that city, by what he termed a *Thermo-lamp*, and I understood he did there exhibit a very brilliant light procured from coal; but the experiment was not pursued, and I heard no more on the subject of his attempts at Baltimore excepting that his plan had not succeeded. In October 1802, Henfrey wrote to Dr. Mease on the subject, giving an account of his plan, and a drawing of his apparatus, which was extremely simple, well calculated for a lighthouse, or a light to be placed high, but too simple for the use of public buildings or private houses. In a small furnace about three feet over and a foot and a half deep, he placed a re[illegible] in which he put his coals: from this retort, a tube b[illegible] at righ angles went into an empty tin vesse , close at the top and bottom, wherein the smoke and vapour was condensed as well as the cold of the atmosphere would effect this purpose. From the top of this vessel a tube arose with a cock inserted in it; this tube opened into the air and served to ascertain when the gas came over in a proper state to be burnt: when it did so, the cock of this tube was turned, and by another tube (furnished also with a stop cock) the gas was conveyed to the place of combustion.

In the same winter Dr. Mease read a memoir on gas lights in Philadelphia, and exhibited the gas produced from red cedar, burnt as it issued out of the tube connected immediately with the retort, and without any intervening vessel or apparatus.

Lately, accounts of this gas and methods of obtaining it, for the purpose of lighting up warehouses, &c. have been published by Dr. Henry, Mr. Murdock, Mr. Cooke, Mr. Clegg, Mr. Parker, and Mr. Accum: all of them useful, but none of them descending to some minute precautions in the process, absolutely necessary to safety and success.

The following brief treatise is principally compiled from English publications, but it includes some further practical remarks, that will readily occur to an experienced chymist as important to be attended to, though not to be found in the dissertations I have used. Mr. Accum's book contains several plates of the machinery, and various patterns of gas burners, candelabra, &c. which add greatly to the expense of his publication, and not much to its utility with us. All his apparatus appears to me unnecessarily complicated, and I understand it is not in fact adopted in the large way in London.

Having paid much attention to the numerous drawings and descriptions of machinery for the purpose of obtaining the coal gas, and having also obtained information from intelligent men who had attended to the process in London, particularly from Dr. Bollman, I have presented what I consider as the cheapest, the most simple and most intelligible process; referring however to and discribing the methods employed by Messrs. Clegg, Cooke, Parker, and Accum, that the reader may have an opportunity of consulting what they have proposed, and deciding upon that plan which may appear to him most eligible.

Of the safety, the convenience, the economy, and the beauty of this method of procuring light, no doubt can now remain, after the evidence reported by a committee of the house of commons, and after experiments made on a scale so prodigious as London exhibits. Fifteen miles of the streets of that city were thus lighted at the beginning of last year, and the gas lights still continue to increase in reputation, and become daily more and more in demand. Recently, Covent Garden Theatre has been thus lighted: and considering the dreadful fires that have occurred of late years at the London theatres, this mode of lighting them would not have been adopted, if any doubt existed as to its safety.

In this city, dimly lighted by twelve or thirteen hundred* lamps, some improvement in illumination is obviously desirable. Oil is growing more scarce and dear, and the temptations to uncomfortable parsimony in lighting our streets are every day stronger. That they could be better lighted, and more cheaply lighted by coal gas, there is no doubt.

The dealers in oil, and the makers of candles, may be somewhat affected eight or ten years hence by the general introduction of gas lights, should this take place; but no improvement can be introduced which will not partially interfere with former articles of consumption, and modes of manufacture. The introduction of Argand's lamp, was an improvement that promised largely to supersede the use of candles; but the public are not aware of any detriment produced by this invention. Indeed, there is one reason for introducing gas lights here, which does not exist in England: in that country

* In the parish of St. James, Westminster, there were in 1809, three thousand four hundred and thirty houses. These houses and the streets were lighted out of doors by two thousand two hundred public or parish lamps, exclusive of St. James's square, which is lighted separately from the parish establishment, and exclusive of lamps put up by private persons before their doors, and at their own expense. The parish lamps are from thirty to forty feet asunder. St. James's parish is now lighted by about eight hundred gas lights; at least that was the number assigned to it.

the precious article, coal, the foundation of all manufacture, is in universal use, and esteemed as it deserves. Here, we know not yet its value. We do not use it at all in the form of coak for our iron furnaces;* we hardly know the use of it even for steam engines; it forces its way very slowly as fuel in our stoves and houses; we use none of the coal tar for our vessels; and in fact it is to the generality of our people a substance whose great value is experimentally unknown. Whatever tends to bring it into public estimation, will be a public benefit: for the seat of wealth and influence will ultimately be placed in every civilized country, there, where canals centre and coals abound. This is well understood in England, and I hope it will soon be equally well appreciated here; in the middle states especially, which sooner or later must greatly depend on a commerce founded on manufacture.

I have proposed in this treatise, rather to inform the public, than men of science. It is unnecessary to dwell on the expediency of using coal gas to the latter class of society; but many persons are interested in the experiment, who have not yet the means of judging whether it can and ought to be made in our own country upon a large scale. To supply this information I have written the following essay; wherein, although I could not altogether avoid introducing, I have introduced very sparingly any terms of science not generally known. T. C.

* I am well persuaded that the natural charcoal, the anthracite of Rhode-Island, and which abounds to the east of the N. E. branch of Susquehanna from the Great Bend to the heads of the Schuylkill, might be advantageously employed instead of the charcoal of wood in our iron-works.

CONCERNING GAS LIGHTS.

CHAPTER I.

Theory of the combustion of Oil and Tallow, used for the purpose of furnishing Light.

When oil is burnt in a common lamp, or tallow in a common candle, for the purpose of lighting an apartment, the following circumstances and appearances take place. The wick, when lighted, heats the surrounding oil and tallow, renders it fluid, and absorbs it. The flame is seen bluish at the bottom; white, slightly tinged with yellow, in the middle; and brownish at the pointed top, which usually throws off smoke. Now, as no light can be produced from these combustible substances unless they be burnt: as no combustion can take place without the access of air: as the surrounding air can only have full access to the outside of the wick—the oil and tallow in contact with the air at the outside of the wick, and that alone, suffers combustion, and produces light. All that is absorbed within the centre of the wick, and to which the air has not free access, is not burnt, but distilled off, and produces vapour and smoke, but little or no flame or light. So far from being of use in the process, it is a nuisance of great moment: two thirds of the oil or tallow are thus wasted, the apartment is rendered offensive by the empyreumatic smell of the half-burnt oil or tallow; and the light actually produced is obscured by the mixture of this dense opake smoky vapour and the black charred wick.

Hence it follows that the larger the wick, the more oil or tallow is absorbed, and the more of these substances wasted.

Also, that frequent snuffing is required; the effect of which is, by lessening the bulk of the wick, to increase the proportion of surface exposed to the air, and lessen that portion of wick which serves merely to absorb, and hold, like a retort, the portion of oil or tallow not burnt, but distilled off. A common candle of six in the pound requires to be snuffed about forty-five times during the time it is burning, in order to produce from it the greatest quantity of light; for the burnt or carbonized snuff at the top absorbs the oil to waste, and dims the light produced. It follows also, that a pound of tallow, made into candles of ten to the pound, will produce more light than a pound of the same substance made into candles of four to the pound: for there will be in the former case a greater surface of wick exposed to the action of the atmospheric air—less of the combustible matter employed will be distilled off from the middle of the wick, which the air cannot reach—and more light of course, will be produced in consequence of this more perfect combustion.

It was to remedy this defect that M. Argand, the ingenious inventor of the patent lamp, proceeded upon two principles—first, to increase to the utmost the surface of his wick; and, secondly, to increase the quantity of air applied to it; and in this way to produce a combustion of the whole combustible material absorbed; which he has done. The wick is thin and circular;

there are as many cotton capillary tubes to absorb the oil as in a common thick wick: but, when absorbed, the whole of it is burnt that can be burnt, in consequence of the wick being spread out through a large surface, and a current of air applied both to the outside and the inside of this thin wick; this current is produced by the glass chimney. Stop this current of air, by grasping the apertures below with your hand, and the lamp smokes immediately—the heat being so great as to distil off the oil before the air has time to effect its combustion; restore the current of air, and the lamp smokes no longer.

In a common candle, the wick must be of a certain size, in order to absorb all the tallow melted by the heat of combustion; otherwise, the fluid tallow accumulates, and runs down the side, or as we say, "gutters." Hence it is, that wax candles are so much better than tallow: for, as wax is not so easily melted, they admit a smaller wick, give a clearer light, require less snuffing, and are in these respects more economical, and counterbalance, in some degree, the dearness of the material. Such also, but in a less degree, is the case with spermaceti candles.

Proposals have been made to make candles with small wicks, and to give them an inclination or leaning of thirty or forty degrees, in order that the current of air may carry off the tip of the wick, and dispense with the necessity of snuffing, or, at least, render it less frequent. I have tried these experiments of Mr. Ezekiel Walker, and have found no sufficient motive to adopt them.

The intensity of light, as an object of comparison between two modes of lighting a room, may be tried thus:—Suppose it were required to know how many candles, of a given size, were equal to a patent lamp:—place the lamp at one end of the mantle-piece, and the candles at the other; hold up the snuffer-tray, a book, or any other object of which the shadow can be received on a sheet of white paper against the opposite wall; the object must be held in a line with the middle of the mantlepiece: the lamp will produce one shadow and the candles another; when the shadows are equally dark the lights are equal; the darkest shadow will be produced by the strongest light. This photometer, or measure of light, is easily understood, and accurate enough for all common purposes.

All these objections to wax, tallow, and oil, and many more, are obviated by the use of coal gas; which

First, is totally consumed without residuum.

Secondly, requires no wick of any kind.

Thirdly, requires no snuffing: no snuffers or extinguishers.

Fourthly, the light of it is not obscured by the incombustible mucilage of oil or tallow, or the opake snuff of a wick.

Fifthly, it produces no smoke, and therefore no smell.

Sixthly, it does not soil the furniture.

Seventhly, It is not liable to such accidents as the emitting of sparks, the spilling of oil, or the dropping of tallow. How seldom is it that a mistress of a family can trust a patent lamp to the care of a servant?

Eighthly, the gas light can be transmitted or conducted any where, and disposed in the most beautiful and picturesque forms, for ornament as well as for use.

Ninthly, it is perfectly under the command of the master or mistress of a family, who can keep, if they please, the key of the valve or stop-cock, and thus extinguish in an instant all the lights in any part of the house.

Tenthly, it contributes greatly to warm as well as to illuminate the apartments: for none of the heat, produced by combustion of the gas, is wasted in distilling off superfluous smoke and vapour. This property will by and by introduce it into our kitchens, and among our cooking vessels.

Eleventhly, it can be afforded at a much less price than common candles, where it is procured and supplied on a large scale. In London, the light of three common candles is furnished by the gas companies for three guineas a year; in this country it would probably cost at least eighteen dollars: for every expense attending the establishment will be much higher in Philadelphia than in London.

These advantages over our common oil and tallow lights are indisputable, and ought no doubt to procure for this method of illumination a favourable reception.

CHAPTER II.

Of the coal of the Ohio, Pennsylvania, Rhode Island, Virginia: and of Wood.

Coal may be classed under two grand divisions; the coal that burns with smoke and flame; *bituminous* coal: and the coal that does not burn with smoke and flame, *stone* coal, *glance* coal, *anthracite*, *graphite* coal, *carbonic* coal, *anthracolite*. The former, seems to be wood impregnated with the products of its own distillation under pressure that prevented those products from escaping or being dissipated; the latter seems to have been formed where the liquid and volatile products found means to escape. Both kinds are apt to be mixt with earths, such as the silicious and argillaceous, and to contain more or less of iron combined with sulphur in the form of martial pyrites, or mixed with earths in the coal as an oxyd.

The coal on the Ohio, is I believe, universally bituminous, and belonging to the formations or strata called secondary by the geologists. So also is the coal on the west branch of the Susquehanna, and to the west of that branch far beyond the bounds of Pennsylvania. It abounds on the Juniata, particularly on the Raystown branch: it is found in the bed of the river at Chingleclamoose and all through the north-western counties of this state, to Pittsburgh, and beyond Pittsburgh in all directions. The slaty roof or upper covering of this bituminous coal, is usually impressed with leaves of exotic plants, and contains sulphuret of iron or martial pyrites.

The non-bituminous coal, that emits neither smoke or flame, *anthracite*, as the mineralogists term it, is found in Pennsylvania, on the head waters of the Lacawana in Luzerne county, of the Lehigh, and of the Schuylkill. It reaches down to the navigable waters of the two last mentioned rivers: it is found on the Berwick turnpike road to Lausanne on the Lehigh: it is found as low down the Susquehanna river, as eight miles below Sunbury; it is found near the forges on the Schuylkill on the road from Sunbury to Reading; Wilkesbarrè is built on this coal, which is found there from twenty-five to thirty feet thick. It burns without smoke or flame, it gives a great heat, and is neither more or less than a natural coke, or coal deprived by fire of its bitumen, ammonia, water, and oil; Anthracite, *anthracolite.*

The coal of Rhode Island found in primitive state is also an anthracite, but still more approaching to the character of plumbago or black lead than the coal of Wilkesbarrè and the Lehigh. It is carbon or charcoal intimately united with a portion of siliceous and argillaceous earths, and a small quantity of iron. There seems to be a regular gradation from the most bituminous coal, such as the Cannel coal of Wigan in Lancashire, through all the grades of carbon, or charcoal deprived of bitumen by natural fire, until we come to plumbago or black lead.

Of these coals, the *bituminous* coal alone will answer the purpose of a coal-gas manufactory, and supply the proper charcoal of coal, or coke. Anthracite is a bad material. But of this bituminous coal, the whole state of Pennsylvania, through the counties north and west of the west branch of Susquehanna, is full. The coal of Virginia is also of the same description, though not so rich in bitumen nor so eligible for the purpose as the coal of Pittsburgh. The coal imported from Liverpool is also bituminous, and will answer the views of the manufacturer of coal gas.

Not only coal, but most kinds of wood will also yield a similar gas; especially the resinous woods; but not in equal abundance with bituminous coal, nor is the gas produced, so pure, or the flame from it so bright.

CHAPTER III.

Of the products of distillation of coal and wood.

When coal is burnt in an open fire, as the coals become hot, there appears a dense white smoke occasionally pervaded by flame, which is sometimes bright and sometimes goes out; by degrees the smoke becomes less, the flame more steady, till the whole mass becomes red-hot, and then the smoke and flame cease. In the first part of the process, vapour and uncombustible gases mingle with the carburretted hydrogen or inflammable coal gas; when these have escaped and formed soot, then the coal gas burns steadily, till it leaves nothing but red hot coke. Such also are the appearances of wood burnt in an open fire, though somewhat less marked.

When coal is distilled in a close iron vessel, as in the process for making coal gas, there comes over (when the smoke is condensed)

1st. A thick bituminous substance of the nature of tar.

2d. A watery fluid containing in solution carbonat of ammonia, and some other ammoniacal salts.

3d. An empyreumatic stinking oil that is partly mixed with, and partly swims on the top of this ammoniacal liquor, and partly dissolved in the gases that escape.

4th. Volatile gases, consisting of carburetted hydrogen, carbonic oxyd, and carbonic acid, whereof the first only is inflammable or combustible, and is injured by being mixed with the other gases which are not so.

Such are the products of the distillation when the heat employed does not exceed a full red heat. If it be urged to a full white heat quickly applied, part of the tarry substance and the empyreumatic oil are also converted into these gases.

In the retort there remains the charcoal of coal, that is coke; which strongly approaches in its chemical composition to anthracite. It is the substance generally used in England, and by and by must be used here as the fuel of blast furnaces.

When the apparatus is well constructed and the distillation well conducted, one chaldron of coal of thirty-six bushels upheaped, and weighing from two thousand eight hundred to three thousand pounds, will produce by measure from one and an half to nearly one chaldron and three quarters of coke (or coak) according to Accum in his examination before a committee of the house of commons. According to other witnesses, three bushels of coal weighing two hundred and fifty-six pounds, produced five and an half bushels of coke by distillation in close vessels. When burnt in an open oven one hundred and twenty-five parts coal produced one hundred and sixty pounds coke. Coals loses by distillation from thirteen to fourteen pounds per hundred weight of one hundred and twelve pounds.

Coke when burnt in a grate, will give more heat than coal, in the proportion by measure of three to two, owing in part to about five and twenty per cent loss of small coal, that unavoidably falls through the bars and is lost.

Coke in a furnace will give out nearly three times as much heat as the same weight of coal. But when coal can be so burnt, that none of it shall be lost, somewhat more heat can be produced from the coal itself than from the coke it would produce.

Coke in an open fire will last longer than coal burnt in the usual way in an open grate, in the proportion of four or five to two.

Beside the coke, there are volatile products before stated; as

Coal tar of the consistence of treacle. Of this, coal when distilled will yield from four to five per cent. When this tar is distilled, it yields a volatile oil, and a substance of the nature of pitch. A chaldron of coal weighing from twenty-five to twenty-eight hundred weight, will produce tar, which when distilled will yield sixty pounds of pitch, and about thirty pounds or three gallons of oil. From this pitch about thirty pounds of asphaltum can be procured, fit for black japan varnish. When the pitch is boiled for asphaltum, about fifteen pounds more of oil is procured. This oil can be substituted for most of the purposes of oil of turpentine, and the pitch itself for paying and caulking the bottoms of vessels.

Ammoniacal liquor. A chaldron of coals will yield about eighteen gallons of this liquor weighing one hundred and eighty pounds. Of this ammoniacal liquor, twenty-eight pounds will yield one pound of carbonat of ammonia. Also, fourteen hundred weight of the ammoniacal liquor, mixed with forty-two and three quarter pounds of muriatic acid of commerce, yielded one hundred weight of sal-ammoniac.

But whether the expense of procuring these substances in the large way, would be sufficiently compensated by the sale, has not yet been fully determined, so far as I know. The tar and ammoniacal liquor are usually sold off in these states to persons who use them for their own purposes, or convert them by manufacture into different articles for sale.

Carbonic oxyd and carbonic acid. These come over in the first part of the process with sulphuretted hydrogen; and are separated as much as possible by washing the mixt gases in good lime water of the consistence of cream, and then in common water.

Carburetted hydrogen, or coal gas. Of this, a chaldron of thirty-six upheaped bushels, or from twenty-five to twenty-eight hundred weight, will yield when washed and purified about ten thousand cubic feet.

Of this gas, a flame of equal volume with the flame of a candle, furnishes, by experiment, thrice the quantity of light, ascertained by the respective shadows cast; the candle well snuffed for the purpose, and the flame from the gas burner being carefully brought as near as possible to the same size and shape, with that of the candle.

Such are the products of the distillation of coal.

When *wood* is distilled, we obtain an inflammable liquid tar, soluble in ether, in alcohol, in alkaline lixivia, and in acetic as well as in the mineral acids; it is soluble also in drying oils, and considerably in old and coloured oil of turpentine, but not in the fat oils, or in naptha. Besides this, we obtain a good quantity of empyreumatic acetic acid, usually called pyroligneous acid, and used by the cotton dyers and calico printers to make iron liquor or acetat of iron, for black colours upon cotton.

If this tar, after the acid is washed away in great part, be again subjected to a second distillation, it is converted into a coloured essential oil that sinks in water, and a spongy charcoal; the water of the apparatus also contains acetic acid with a little ammonia. Such are the products, if the fire be managed so as to produce a moderate ebullition of the tar; but if it be conducted hastily and the sides of the retort made very hot, the oil that arises is converted into carbonic acid and carbonic oxyd, mixed with carburetted hydrogen and hydro carbonats. But it produces more carbonic oxyd than coal does, and the gas obtained does not afford so good a flame as the gas from coal. The oil produced from coal tar also, by striking against the sides of the retort strongy heated, is convertible into combustible mixed with uncombustible gases; so that the products of distillation in the first instance, both of coal and wood, depend greatly upon the management of the heat applied. If in distilling the tar from wood, the distillation be stopt when the acetic acid ceases to come over, and the oil begins to acquire a brown colour, the residuum in the retort approaches to the nature either of pitch or asphaltum, according to the degree of heat it has undergone: it is fusible, inflammable, and electric, like resinous bodies, when the fire has not been strongly urged; but on continuing the distillation of the pitch, it passes into asphaltum, and then into a coaly matter, becoming less and less soluble in alcohol, and at last approaching in character to black lead. Hence both in coal and in wood, fire decomposes, volatilizes, and converts into gases the combinations of which hydrogen forms a large part, much sooner than the carbon, most of which remains in the coaly residuum. The process of nature, as I have before observed, seems much the same in the produce of natural bitumen, petroleum and bituminous coal, through all its gradations, till it becomes anthracite and plumbago. Whether water or fire converted the original vegetable into coaly substance is a needless inquiry here, and not yet determined any where. The lignites from peat through Surturbrand, and Bovey coal, to Jet, seem to have been produced by the action of water according to the experiments and observations of Mr. M'Culloch: and indeed as appears from the production of peat moss by means of submerged forests.

With respect to these products of the distillation of wood, no information appears yet as to their value. The charcoal remaining in the retort and the tar, are obviously saleable articles in this country; but the pyroligneous acid, is not yet so, inasmuch as we have not a sufficient number of dying and calico-printing establishments to create a demand for it.* From the oil of wood tar, there may be by means of fire an excellent *bistre*, fit for the use of painters. Such are the products obtained from the substances employed to produce also the inflammable gas called carburetted hydrogen, which furnishes gas light. For this purpose coal is better than wood.

The following observations of Mr. Accum on the products obtained by distilling coal, deserve attention:

"Having thus far considered the nature of coal gas as a substitute for the lights now in use, it will be necessary to attend more particularly to some other pro-

* Messrs. Mollerat in Paris attempted a vinegar establishment, wherein it was made from pyroligneous acid, but they failed.

ducts which are obtained during the production of this species of light; namely, coke, tar, ammoniacal liquor, &c.

"*Coke.*—The substance called coke, which constitutes the skeleton of the coal, or its carbonaceous base, is left behind in the retort, after all the evaporable products have been expelled from the coal by heat.

"It is sufficiently known, that coke is a more valuable fuel than the coal from which it is obtained.

"Hence, immense quantities are prepared in the large way, but the gaseous and other substances are lost in the process employed for carbonizing the coal.* In the manufacture of coal gas the coke comes from the retort, enlarged in size and greatly diminished in weight,

* The preparation of coke is as follows:—A quantity of large coal is placed on the ground in a round heap, of from twelve to fifteen feet in diameter, and about two feet in height; as many as possible of the large pieces are placed on their ends, to form passages for the air; above them are thrown the smaller pieces and coal dust, and in the midst of this circular heap, is left a vacancy of a foot wide where a few faggots are deposited to kindle it. Four or five apertures of this kind are formed round the ring, particularly on the side exposed to the wind; there is, however, seldom occasion to light it with wood, for other masses being generally on fire, the workmen most frequently use a few shovels of coal already burning, which acts more rapidly than wood, and soon kindles the surrounding pile; as the fire spreads, the mass increases in bulk, puffs up, becomes spongy and light, cakes into one body, and at length loses its volatile parts, and emits no more smoke. It then acquires an uniform red colour, inclining a little to white, in which state it begins to break into gaps and chinks, and assumes the appearance of the under part of a mushroom; at this moment the heap must be quickly covered with ashes, of which there is always a sufficient provision around the numerous fires, where the coke is prepared.

when compared with the original coal. In whatever state the coal may be when introduced into the retort, the coke is uniformly taken out in large masses, so that the refuse coal, or dust, and sweepings of the pit, which are now thrown away, may be employed and converted into an excellent fuel. Coke is decidedly superior to coal for all domestic, and more especially for culinary purposes; the heat which it throws out being more uniform, more intense, and more durable. No flame, indeed, accompanies it, and it seldom needs the application of the poker—that specific for the *ennui* of Englishmen; but these deficiencies are more than balanced by the valuable property of emitting no sparks, of giving more heat, and burning free from dust and smoke.

"That coke must give out more heat during its combustion than coal, will at once become obvious, when we consider that the quantity of matter which, in the combustion of coal is changed from a solid to a state of elastic fluidity, must necessarily carry off a portion of caloric, which then becomes converted in a latent state without producing heat, whilst the glow of the coke radiates caloric with an intensity unimpaired by any demand of this kind.

"It is thus that coke, though somewhat more difficult of ignition than common coal, always gives out a more steady, a more lasting, and a more intense heat.

"The only inconveniencies that attend the use of coke is, that, as it consumes, it leaves much more ashes than common coal, charcoal, or wood; and these much heavier too, which are, therefore, liable to collect in such quantity as to obstruct the free passage of air through the fire; and further, that when the heat is *very intense*, these ashes are disposed to melt or vitrify into a tenacious drossy substance, which clogs the grate, the sides of the furnace, and the vessels. This last inconvenience is only troublesome, however, when the heat required is very great. In ordinary heats, such as are produced by kitchen or parlour grates, the ashes do not melt, and though they are more copious and heavy than those of charcoal or wood, they do not choke up the fire, unless the bars of the grate be too close together.

"The relative effects of heat produced by coke and coal are as follows:

"Six hundred pounds of pit-coal are capable of evaporating ten cubic feet of water in twenty hours, and four hundred and thirty pounds of coke are capable of evaporating seventeen cubic feet of water in twelve hours and a half.*

* In order to learn the relative effect of different kinds of fuel, with regard to their capability of producing heat, chymistry teaches that equal quantities of fuel alike expended, will raise the temperature of a given quantity of water through the same number of degrees, whence, by knowing the original quantity and temperature of water, together with the quantity of fuel expended to raise the water to the boiling point, the result sought may be expressed by stating the quantity of water at 30 degrees, which would have been raised 180 degrees by one pound of the fuel employed, or in the form of a rule.

Multiply the quantity of water by the number expressing the degrees actually raised; multiply the number of pounds of fuel expended by one hundred and eighty degrees. Divide the first product by the latter, and the quotient will express the water which would have been raised one hundred and eighty degrees by one pound of the fuel. Or equal quantities of water may be com-

"The earl of Dundonald has shown that, in the application for burning lime, a quantity of coke uniformly burns a given portion of lime-stone in one-third part of the time that the quantity of coal from which the coke had been made could do.

"This effect is to be accounted for from having previously freed the coal, or rather its coke, from the moisture and the tar, which it sends out during combustion, and which condenses on the middle and upper strata of stratified limestone and coal in the lime kiln, and impedes the whole mass of materials from coming into a rapid and complete ignition; because the greater the quantity of materials, and the sooner the whole is ignited, the better and more economically the lime is burned, both as to coals and time; the saving of which last is a material object, especially at lime kilns, where there is in the summer time a great demand for lime; the coke occasioning the kilns to hold a *third more lime* at the *same time*.

"In the art of making bricks, in the smelting of metallic ores, and the drying of malt, the advantages of coke over coal, are sufficiently known.

"The following account given by Mr. Davis,* shows that the advantages that may be derived in the processes of burning lime, plaster of paris, and bricks,

pletely evaporated under equal surfaces and circumstances, with the different kinds of fuel, the nature of which is to be examined; the quantities of fuel expended for that purpose give the relative effect of the different kinds of fuel, with regard to their power of producing heat.

*Philosophical Magazine, Vol. 33, p. 433.

by means of coke, are greater than at first sight might be imagined:

"The coke obtained in the gas process is so valuable, that it appears inexplicable that men should not avail themselves of this mode of procuring light, to the almost total exclusion of all other methods now in use. As a landholder, placed among an industrious but wholly illiterate society of men, I have had the more opportunity of trying this species of fuel or coke, which I could not otherwise procure in this sequestered spot, at a tolerably cheap rate, for purposes to which it has not, as far as I know, been hitherto employed. I must tell you that I am my own lime-burner, plaster of paris baker, and brick-maker; and that in these processes of rural economy I have derived the greatest benefits from this species of fuel, which I now prepare at a cheap rate, although I waste almost the whole of the light of the coal gas intentionally. The coal which I employed formerly for the burning of limestone into lime, is a very inferior kind of small coal, called here Welsh culm. The kiln for burning the limestone into lime is a cup-shaped concavity, surrounded with solid brick-work, open at the top, and terminating below by an iron grate. It has a stone door that may be opened and closed for charging and emptying the furnace when required. This furnace I formerly charged with alternate strata or layers of small coal and limestone, the latter being broken previously into pieces not larger than a man's fist, until the kiln was completely filled. The stone is thus slowly decomposed; the upper part of the charge descends, and when it has arrived at the bottom of the furnace new strata are super-imposed, so as to keep the furnace continually full during a period of fifty hours. The quantity of lime I procured with small coal formerly amounted to eighty-five bushels. The strata of coal necessary for the production of this quantity of lime require to be four inches thick, and the time necessary for calcination was, as stated already, fifty hours.

"On applying coke instead of coal the produce of lime may be increased to nearly thirty per cent. from the same furnace, and the time required to effect the calcination of this quantity of lime-stone is reduced to thirty nine hours: it also requires *less attendance* and *less labour*, and the whole saving thus accomplished, amounts to more than fifty *per cent. on the lime-kiln.*

"I have lately also employed coke for the burning of bricks. My bricks are burnt in clamps made of bricks themselves. The place for the fuel, or fire-place, is perpendicular, about three feet high. The flues are formed by gathering or arching the bricks over, so as to leave a space between each of a brick's breadth; and as the whole of the coal, if this fuel be employed, must, on account of the construction of the pile, be put in at once, the charge of the bricks is not, and never can be, burnt properly throughout; and the interference of the legislature, with regard to the measurement of the clamp, is a sufficient inducement for the manufacturer to allow no more space for coal than he can possibly spare.

"If coke be applied instead of coal, the arches, or empty spaces in the clamp or pile, as well as the strata of the fuel, may be considerably smaller: the heat produced in this case is more uniform and more intense, and a saving of thirty per cent. at least is gained.

"In the baking my own plaster-stone I also employ coke. The calcination of the stone for manure I perform in a common reverberatory furnace, and the men who conduct the process (who are otherwise averse to every thing new) are much pleased with the steadiness of the fire, and little attendance which the process requires, when coke is used instead of coal.

"These are the few facts I wish to state, with regard to the useful application of this species of fuel, which, no doubt, hereafter will become an object of economy of incalculable advantage to individuals, if its nature be better understood than it is at present."

"The quantity of coke obtainable from a given quantity of coal varies according to the nature of the coal employed. One chaldron of Newcastle coal produced, upon an average, in the gas light manufacture, from one chaldron and a quarter to one chaldron and a half of well formed coke. If the carbonization of the coal has been carried to its utmost point, the coke produced, has a brilliant silvery lustre. Such coke is excellent for metallurgical operations, because it stands the powerful blast of the bellows, but for culinary and other purposes of domestic economy, the carbonization should not be carried so far, because, the coke then produced, kindles more readily and makes a more cheerful fire.

"*Coal-tar, oil* and *pitch.*—Another valuable product obtainable from pit-coal, is coal-tar.* This sub-

* In the year 1665, Becher, a German chymist, brought to England his discovery of extracting tar from coal, this distillation he performed in close vessels. It is not mentioned in the records of the time, whether Becher obtained, or rather collected any other articles than the tar.

stance is deposited, in the purifaction of the coal-gas, in a separate vessel destined to receive it.

"The coal-tar is so called from its resembling common tar in its appearance, and most of its qualities.

"Several works have been, at different times, erected both in England and on the continent, to procure from coal a substitute for tar; but they turned out unprofitable speculations. In 1781, the earl of Dundonald invented a mode of distilling coal in the large way, which enabled him not only to form coke, but, at the same time to save and collect the tar. Even this process, however, for which a patent was taken out, has gained very little ground. Its object was still too limited: for though some of the ingredients of coal were procured, they were procured at an expense that nearly balanced the profits; and no attention whatever was paid to the coal-gas, which constitutes the most important part of coal.

"Coal-tar may be used with advantage for painting and securing wood that is exposed to the action of air or water. The wood being warmed, the tar is applied cold, and penetrating into the pores, gives the timber an uncommon degree of hardness and durability.

"One chaldron of Newcastle coal produces in the gas light manufacture from one hundred and fifty to one hundred and eighty pounds of tar, according to the circumstances under which it is produced.

"The tar obtained from Newcastle coal is specifically heavier than that produced from cannel coal; hence it sinks in water, whereas the latter swims on the surface of that fluid.

"To render the tar fit for use, it requires to be evaporated to give it a sufficient consistence. If this process be performed in close vessels, a portion of an essential oil is obtained, which is known to colourmen by the name of oil of tar. To obtain this oil, a common still is filled with the coal-tar, and, being properly luted, the fire is kindled and kept up very moderate, for the tar is very apt to boil up in the early part of the process. The first product that distils over is principally a brown ammoniacal fluid, mixed however with a good deal of oil. As the process advances, and the heat is increased, the quantity of ammoniacal liquor lessens, and that of oil increases, and towards the end of the distillation the product is chiefly oil.

"The oil and ammoniacal water which distil over do not mix, so that they may be easily separated by decantation. The oil is a yellowish inferior kind of oil of turpentine, which is very useful in painting ships, for making varnishes, and other coarse out-door work.

"Two hundred pounds of tar produce, upon an average, fifty-three pounds of essential oil.

"If the coal-tar is wanted to be converted into pitch, without obtaining the oil which it is capable of furnishing, the evaporation of it may be performed in a common boiler; but as it is extremely liable to boil over, the greatest precaution is necessary in conducting the evaporation. A boiler constructed on the plan of Mr. Thomas Smith (Am. Ph. Trans.) is very convenient for the conversion of coal-tar into pitch. The contrivance consists in adding a spout, or rim, to the common boiler, into which spout the tar spreads itself as it rises, and by this means becomes cooled, and the boiling over is checked.

"1000lb. of coal-tar produce, upon an average, from 460 to 480lb. of pitch. A subsequent fusion with a gentle heat, converts the coal-pitch into a substance possessing all the characters of *asphaltum*.

"*Ammoniacal fluid.*—The properties of the ammonial liquor, which accompanies the tar, and which is deposited in the tar cistern, has not yet been fully investigated. It is employed already in the manufacture of muriate of ammonia (sal ammoniac.)' One chaldron of coal affords from 220 to 240lb. of this ammoniacal fluid, which is composed chiefly of sulphate, and carbonate of ammonia.—Such are the products obtainable from coal.

CHAPTER IV.

An account of what has been done in England on the subject of Gas Lights.

So little has been put in practice in France respecting gas lights, that although it has been used once or twice as a thermo-lamp, the art of lighting the streets or apartments has not been made a distinct business there, or carried to any degree of perfection, or indeed, so far as I know, used at all. The French savans, or men of science, are not inferior to the English; but in respect of the mechanic arts, in a large way, that nation is half a century behind Great Britain. They have more taste and more neatness in ornamental work, and in trinkets, but they fall far short of their rivals in almost every manufacture that contributes to national comfort, or national power. I wish I could say that we were at a less distance in this respect from the manufacturers and artizans of the mother country, whom we scarcely equal in any thing except ship-building. Nor shall we, till mathematics and chymistry come to be considered as indispensable branches of good education in every seminary on the American continent.

The following history of the proceedings respecting gas lights, by Mr. Accum, is sufficiently accurate:

" *Sketch of the Rise and Progress of the Discovery and Application of Coal-gas, as a Substitute for procuring Artificial Light.*

" To assist the reader in comprehending the nature and object of substituting coal-gas for tallow or oil, for the purpose of obtaining light, it may be proper to touch slightly upon the successive discoveries that have been made as to the decomposition of coal, and the application of its different ingredients. Such a sketch will add to the many examples that occur in the history of science and art, showing the slow progress of mankind in following up known principles, or extracting from acknowledged facts every possible advantage.

" In the Philosophical Transactions of the Royal Society, Vol. XLI, so long ago as the year 1739, is recorded a paper, exhibiting an account of some experiments made by Dr. James Clayton, from which it appears that the inflammable nature of coal-gas was then already known. Dr. Clayton, having distilled New-castle coal, obtained, as products of the process, an aqueous fluid, a black oil, and an inflammable gas which he caught in bladders, and by pricking these he was enabled to inflame the gas at pleasure.

"It is further known, that in the beginning of the last century, Dr. Hales,* on submitting pitcoal to a chymical examination, found, that during the ignition of this fossil in close vessels, nearly one-third of the coal became volatilized in the form of an inflammable vapour. Hence the discovery of the inflammable nature of coal-gas can no longer be claimed by any person now living.

"In the year 1767, the bishop of Llandaff† examined the nature of the vapour and gaseous products evolved during the distillation of pit-coal. This learned philosopher noticed, that the volatile product is not only inflammable as it issues from the distillatory vessel, but that it also retained its inflammability after having been made to pass through water, and suffered to ascend through two high curved tubes. The solid matters obtained by this venerable prelate, were an aqueous ammoniacal fluid, a tenaceous oil, resembling tar, an ammoniacal liquor, and a spongy coal, or coke.

"The first discovery and application of the use of coal-gas for the purpose of illumination is claimed by Mr. Murdoch.

"Dr. W. Henry, of Manchester, has published the following account‡ of this discovery.

* Vegetab. Statics, vol. I.

† Watson's Chymical Essays, vol. II.

‡ Thompson's System of Chymistry, vol. I. p. 52.

" 'In the year 1792, at which time Mr. Murdoch resided at Redruth, in Cornwall, he commenced a series of experiments upon the quantity and quality of the gases contained in different substances. In the course of these he remarked, that the gas obtained by distillation from coal, peat, wood, and other inflammable substances, burnt with great brilliancy upon being set fire to; and it occurred to him, that by confining and conducting it through tubes, it might be employed as an economical substitute for lamps and candles. The distillation was performed in iron retorts, and the gas conducted through tinned iron and copper tubes to the distance of seventy feet. At this termination, as well as at intermediate points, the gas was set fire to, as it passed through apertures of different diameters and forms, purposely varied with a view of ascertaining which would answer best. In some the gas issued through a number of small holes like the head of a watering pan; in others it was thrown out in thin long sheets; and again in others in circular ones, upon the principle of Argand's lamp. Bags of leather and of varnished silk, bladders, and vessels of tinned iron, were filled with the gas, which was set fire to, and carried about from room to room, with a view of ascertaining how far it could be made to answer the purpose of a moveable or transferable light. Trials were likewise made of the different quantities and qualities of gas produced by coals of various descriptions, such as the Swansea, Haverfordwest, Newcastle, Shropshire, Staffordshire, and some kinds of Scotch coals.

" 'Mr. Murdoch's constant occupations prevented his giving farther attention to the subject at that time; but he again availed himself of a moment of leisure to repeat his experiments upon coal and peat at Old Cumnock, in Ayrshire, in 1797; and it may be proper to notice that both these, and the former ones, were exhibited to numerous spectators, who, if necessary, can attest them. In 1798 he constructed an apparatus at Soho foundry, which was applied during many successive nights to the lighting of the building; when the experiments upon different apertures were repeated and extended upon a large scale. Various methods were also practised of washing and purifying the air, to get rid of the smoke and smell. These experiments were continued, with occasional interruptions, until the epoch of the peace in the spring of 1802, when the illumination of the Soho manufactory afforded an opportunity of making a public display of the new lights, and they were made to constitute a principal feature in that exhibition.'

"In the year 1803 and 1804, Mr. Winsor exhibited at the Lyceum, in London, the general nature of this new mode of illumination, though the machinery for procuring, and the manner of purifying the gas, he kept a secret. He exhibited the mode of conducting the gas through the house, and a number of devices for chandeliers, lamps, and burners, by which it might be applied. Among these he proposed long flexible tubes suspended from the ceiling, or wall of the room, and at the end communicating with burners, or lamps, of different kinds. This gentleman showed also by experiment, that the flame of the gas light produced no smoke; that it was not so dangerous as the flame of candles or lamps; that it could not produce sparks; and that it was not so readily extinguished by gusts of wind or torrents of rain.

"Mr. Winsor's display of gas lights took place more than two years before Mr. Murdoch's priority of right was heard of.

"In stating these facts I do not mean to say that Mr. Murdoch derived the hint of applying the coal-gas from the previous exhibition of Mr. Winsor, because it is quite within the bounds of probability that the ideas of Mr. Murdoch may have arisen totally independent of all acquaintance with Mr. Winsor's.

"The claims of invention, or the determination of the right of priority, concerns the public only so far as the honour and estimation of any useful discovery conferred on the inventor may induce other individuals to devote their talents to similar pursuits; by means of which, more discoveries may be made, and the subject of human invention become extended, or rendered more useful. For as the mere benefits which mankind may derive from any particular discovery, they are certainly more indebted to the person who first applied the discovery to actual practice, than to him who first made it, and merely illustrated it by barren experiments. Mr. Winsor certainly pressed on the mind of the public with unremitted perseverance and diligence the extensive application of gas light in the year 1802, but he made no new discovery with regard to the composition of coal; he did not even invent the mode of conducting the gas through tubes; and if he has pointed out the particulars of the process, he has made a very important, though not the most brilliant improvement in this line of business. Mr. Winsor's publications are, perhaps, but ill adapted to promote his cause; and the exaggerated calculation which the sanguine mind of a discoverer is naturally disposed to indulge in, have, to superficial observers, thrown an air of ridicule and improbability on the whole scheme of lighting with gas.

"It may, however, be safely affirmed, that if the same facts had come forward under the sanction of some great name in the chymical or philosophical world, the public incredulity would long since have been subdued; and the plan, which for many years has been struggling for existence, would have been eagerly adopted as a national object.

"On the 18th of May, 1804, Mr. Frederick Albert Winsor took out a patent for combining the saving and purifying of the inflammable gas, (for producing light and heat,) the ammonia, tar, and other products of pit-coal, with the manufacture of a superior kind of coke, (see Repertory, 2d series, v. 172.) And, lately, the same gentleman has taken out a second patent, for further improvement in these processes.

"In the year 1805, Mr. Northern, of Leeds, also directed the attention of the public to the application of coal gas, as a substitute for tallow light, as will be seen by the following extract of the Monthly Magazine for April, 1805.

"'I distilled in a retort fifty ounces of pit-coal in a red heat, which gave six ounces of a liquid matter covered with oil, more or less fluid as the heat was increased or diminished. About twenty-six ounces of cinder remained in the retort; the rest came over in the form of air, as it was collected in the pneumatic apparatus. I mixed part of it with atmospherical air, and fired it with the electric spark with a tolerable explosion, which proves it to be hydrogene.—Whether any of the other gases were mixed with it, I did not then determine. In the receiver I found a fluid of an acid taste, with a great quantity of oil, and, at the bottom, a substance resembling tar.

" 'The apparatus I make use of for producing light is a refiner's crucible, the top of which (after filling with coal) I close with a metal cover, luted with clay or other luting, so as to prevent the escape of the gas; a metal pipe is soldered into the cover, bent so as to come under the shelf in the pneumatic trough, over which I place a jar with a stop-cock and a small tube; the jar being previously filled with water, the crucible I place on the common or other fire as is most convenient; and as the heat increases in it, the gas is forced rapidly through the water into the jar, and regularly displaces it. I then open the cock and put fire to the gas, which makes its escape through the small tube, and immediately a most beautiful flame ensues, perfectly free from smoke or smell of any kind. A larger light, but not so vivid or clear, will be produced without passing the gas through water, but attended with a smoke somewhat greater than that of a lamp charged with common oil.

" 'I have great hopes that some active mechanic or chymist will, in the end, hit on a plan to produce light for large factories, and other purposes, at a much less expense, by the above or similar means, than is at present produced from oil.'

"Soon afterwards, Mr. Samuel Cleg, of Manchester, engineer, communicates an account of his method of lighting up manufactories with gas light to the Society of Arts, for which he received the silver medal.

"Since that time the application of gas light has spread rapidly, and numerous manufactories and other establishments have been lighted by coal gas.*

"In France, the application of gas lights to economical purposes, was pointed out long before it was publicly introduced into this country. M. Le Bon had a house fitted up in Paris, in the winter of 1802, so as to be entirely illuminated by gas lights, which was seen by thousands with admiration; and had a *brevet d'invention* (patent) granted to him by the French government, for the art of producing light from wood, ignited in close vessels.

"Many other attempts have been made to derive advantage from the different ingredients of coal; but they are too obscure to merit particular enumeration.

"In the year 1808, Mr. Murdoch presented to the Royal Society his account of the application of gas light, and was complimented with count Rumford's medal for the same.

"The following statement is taken from Mr. Murdoch's paper.

"'The whole of the rooms of the cotton mill of Mr. Lee, at Manchester, which is, I believe, the most extensive in the united kingdom, as well as its counting-houses and store-rooms, and the adjacent dwelling

"* This gentleman is at present engineer to the Gas Light Company."

house of Mr. Lee, are lighted with the gas from coal. The total quantity of light used during the hours of burning has been ascertained, by a comparison of shadows, to be about equal to the light which 2500 mould candles, of six to the pound, would give; each of the candles with which the comparison was made consuming at the rate of $\frac{4}{10}$ths of an ounce (175 grains) of tallow per hour.

" ' The gas burners are of two kinds: the one is upon the principle of the Argand lamp, and resembles it in appearance; the other is a small curved tube with a conical end, having three circular apertures or perforations, of about a thirtieth of an inch in diameter, one at the point of the cone, and two lateral ones, through which the gas issues, forming three divergent jets of flame, somewhat like a fleur-de-lis. The shape and general appearance of this tube has procured it, among the workmen, the name of the cockspur burner.

" ' The number of burners employed in all the buildings amounts to 271 Argand, and 653 cockspurs, each of the former giving a light equal to that of four candles of the description above-mentioned; and each of the latter a light equal to two and a quarter of the same candles; making therefore the total of the gas light a little more than equal to that of 2500 candles, six to the pound. When thus regulated, the whole of the above burners require an hourly supply of 1250 cubic feet of the gas produced from cannel-coal; the superior quality and quantity of the gas produced from that material having given it a decided preference in this situation over every other coal, notwithstanding its higher price.

" 'The time during which the gas light is used may, upon an average of the whole year, be stated at least at two hours per day of twenty-four hours. In some mills, where there is over work, it will be three hours; and in the few where night work is still continued nearly twelve hours. But taking two hours per day as the common average throughout the year, the consumption in Messrs. Philips and Lee's mill will be 1250 + 2 = 2500 cubic feet of gas per day; to produce which 700 weight of cannel-coal is required in the retort. The price of the best Wiggan cannel-coal (the sort used) is 13½*d.* per cwt. (22*s.* 6*d.* per ton) delivered at the mill, or say about eight shillings for the seven hundred weight. Multiplying by the number of working days in the year, (313) the annual consumption of coal will be 110 tons, and its cost 125*l.*

" 'About one-third of the above quantity, or say forty tons of good common coal, value ten shillings per ton, is required for fuel to heat the retorts, the annual amount of which is 20*l.*

" 'The 110 tons of cannel-coal, when distilled, produce about 70 tons of good coke, which is sold upon the spot at 1*s.* 4*d.* per cwt. and will therefore amount annually to the sum of 93*l.*

" 'The quantity of tar produced from each ton of cannel-coal is from eleven to twelve ale-gallons, making a total annual produce of about 1250 ale-gallons, which not having been yet sold, it cannot yet be determined its value.

" 'The interest of the capital expended in the necessary apparatus and buildings, together with what is considered as an ample allowance for wear and tear, is stated by Mr. Lee at about 550*l.* per annum, in which some allowance is made for this apparatus being made upon a scale adequate to the supply of a still greater quantity of light than he has occasion to make use of.

" 'Mr. Lee is of opinion that the cost of attendance upon candles would be as much, if not more, than upon the gas apparatus; so that, in forming the comparison, nothing need be stated upon that score on either side.

" 'The economical statement for one year, then, stands thus:

Cost of 110 tons of cannel-coal -	125*l.*
Ditto of 40 tons of common ditto, to carbonise - - -	20
In all	145
Deduct the value of 70 tons of coke -	93
The annual expenditure in coal, after deducting the value of the coke, and without allowing any thing for the tar, is therefore - - -	52
And the interest of capital sunk, and wear and tear of apparatus - -	550
Making the total expense of the gas apparatus per annum, about -	600

" 'That of candles, to give the same light, would be about 2000*l.* For each candle, consuming at the rate of $\frac{4}{10}$ths of an ounce of tallow per hour, the 2500 candles burning, upon an average of the year, two hours per day, would, at one shilling per pound, the present price, amount to nearly the sum of money abovementioned.

" 'If the comparison were made upon an average of three hours per day, as in most cases, would perhaps be nearer to the truth, and the tear and wear remaining nearly the same as on the former case, the whole cost would not exceed 650*l.* while that of the tallow would be 3000*l.*'

" Mr. Ackerman, in London, has shown that the art of gas light illumination is not confined to great manufactories, but that its advantages are equally applicable to those on a moderate scale. The whole of Mr. Ackerman's establishment, his public library, warehouse, printing offices and work shops, together with his dwelling house, from the kitchen to the drawing room, has, for these four years past, been lighted with gas, to the total exclusion of all other lights. The result of the whole of this proceeding will be obvious from the following letter:

TO MR. ACCUM.

" Sir,

" In answer to your request, with regard to my gas lights, which I now have in my house, I take this mode of informing you, that I charge two retorts with 240lbs. of coal, half cannel and half Newcastle, from which I extract 1000 cubic feet of gas. To obtain this quantity of gas, when the retorts are cold, I use from 100 to 110lbs. of common coals; but when they are in a working state, that is to say, when they are once red hot, the carbonising fuel amounts to about 25lbs. per retort. The bulk of gas thus obtained supplies 40 Argand's lamps, of the large size, for four hours per night, during the long winter evenings, together with eight Argand's lamps and about 22 single cockspur burners, for three hours per night: in addition to which my printers employ 16 cockspur burners for ten hours per day to heat their plates instead of charcoal fire. In the depth of winter we charge two retorts per day: but, upon an average, we work 365 retorts in 365 days.

" Now 365 retorts, containing 120lbs. of coal each, make 43800lbs. which is equal to ten chaldrons of Newcastle and eight tons of cannel coal.

	l.	s.	d.
10 chaldrons of Newcastle coals, at 65s. make	32	10	0
8 tons of cannel coal,* (this coal is sold by weight) at 100s. per ton	40	0	0
7 chaldrons of common coals for carbonising, at 55s.	19	5	0
To wages paid the servant for attending the gas apparatus	30	0	0
Interest of money sunk	30	0	0
The wear and tear of the gas light apparatus I consider to be equal to the wear and tear of lamps, candlesticks, &c. employed for oil, tallow, &c.			
Total expense of the gas lights	151	15	0

DEDUCT

23 chaldrons of coke, at 60s. per chaldron	69			
Ammoniacal liquor	5			
Tar	6			
Charcoal employed by the copper-plate printers to heat their plates, which is now done with the gas light flame, cost, annually	25			
Two chaldrons of coals *minus* used as fuel, for warming the house, since the adoption of the gas lights, at 65s. per chaldron	6 10			
		111	10	0
Nett expenses of the gas lights		40	5	0
The lights used in my establishment, prior to the gas lights, amounted annually to		160	0	0
My present system of lighting with gas costs, per ann.		40	5	0
Balance in favour of the gas for one year		119	15	0

"Such is the simple statement of my present system of lighting, the brilliancy of which, when contrasted with our former lights, bears the same comparison to them as a bright summer sun-shine does to a murky November day: nor are we, as formerly, almost suffocated with the effluvia of charcoal and fumes of candles and lamps. In addition to this, the damage sustained by the spilling of oil and tallow upon prints, drawings, books and paper, &c. amounted annually to upward of 50*l*. All the workmen employed in my establishment consider their gas lights as the greatest blessing: and I have only to add, that the light we now enjoy, were it to be produced by means of Argand's lamps or candles, would cost at least 350*l*. per annum.

"I am, with respect,
"Yours,

"R. Ackerman.

"Strand, March 13, 1815."

* Although cannel coal sells at nearly double the price of Newcastle coal, I use it in preference to the latter, because it affords a larger portion of gas, and gives a much more brilliant light.

" Another manufacturer, who was one of the first that adopted the use of this method of illumination in the small way, and who gave a statement of its advantages to the public, is Mr. Cook, a manufacturer of metal toys, at Birmingham, a clear-headed, prudent man, not apt to be dazzled by a fanciful speculation, but governed in his transactions by a simple balance of profit and loss. There is a *naivete* in his own account of the process which will amuse as well as instruct the reader.

" 'My apparatus is simply a small cast iron pot, of about eight gallons, with a cast iron cover, which I lute to it with sand. Into this pot I put my coal. I pass the gas through water into the gasometer or reservoir, which holds about 400 gallons; and, by means of old gun-barrels, convey it all round my shops. Now, from twenty or twenty-five pounds of coal, I make perhaps six hundred gallons* of gas; for, when my reservoir is full, we are forced to burn away the overplus in waste, unless we have work to use it as it is made: but, in general, we go on making and using it, so that I cannot tell to fifty or a hundred gallons;—and, in fact, a great deal depends on the coals, some coals making much more than others. These twenty-five pounds of coal put into the retort, and say twenty-five pounds more to heat the retort, which is more than it does take one time with another, but I am willing to say the utmost, are worth four-pence per day. From this four-pence we burn eighteen or twenty lights during the winter season.'

" Thus are the candles, which Mr. Cook used to employ, and which cost him three shillings a day, en-

* A wine-gallon is equal to 231 cubic inches.

tirely superseded. But, besides his expense in candles, oil and cotton for soldering, used to cost him full 30*l.* a year, which is entirely saved, as he now does all his soldering by the gas flame only. For, 'in all trades in which the blow-pipe is used with oil and cotton, or where charcoal is employed to produce a moderate heat, the gas flame will be found much superior, both as to quickness and neatness in the work: the flame is sharper, and is constantly ready for use; while, with oil and cotton or charcoal, the workman is always obliged to wait for his lamp or coal getting up; that is, till it is sufficiently on fire to do his work. Thus, a great quantity of oil is always burned away useless; but, with the gas, the moment the stop-cock is turned, the lamp is ready, and not a moment is lost.' We must refer to Mr. Cook's letter for the details of expense, which he gives with faithful minuteness, and always leaning to the side unfavourable to the gas. The result of the whole is, that he saves 30*l.* out of the 50*l.* which his lights formerly cost him: and, when we consider that his calculation allows the gas lights to burn the whole year, and the candles only twenty weeks, there can be little doubt, that the savings in this case follow nearly the same proportion as in the former. If the apparatus be erected even on a smaller scale, 'the saving,' Mr. Cook assures us, 'will still be considerable: for the poor man, who lights only six candles, or uses one lamp, if the apparatus is put up in the cheapest way possible, will find it only cost him 10*l.* or 12*l.* which he will nearly, if not quite, save the first year.'

"Mr. Ackerman, having in this town, set the example of lighting his establishment with gas, several other individuals soon followed the attempt. The following statement will show, that this species of light may be made use of with the greatest advantage, upon a still smaller scale, where no great nicety with regard to the apparatus for procuring gas is required. The following report I have received from Messrs. Lloyd, of Queen Street, Southwark, thimble manufacturers and whitesmiths, who have used the gas light for soldering and other purposes these five years past.

From 4 pecks or 1 bushel of coals, weighing 69lbs. for which we now pay (1809) 1*s*. we produce 4_3 pecks of coke, and $\frac{1}{2}$ peck of coal not carbonised remains in the distilling pot, which together with the coke weighs 58lbs. 6 oz. value at 1*s*. per bushel	0	1	4
We procure 6lbs. 4 oz. of tar, which we use as pith—it saves us	0	1	0
	0	2	4
Deduct for coal	0	1	0
Profit on coke and tar	0	1	4
The gas yielded by the four pecks of coals in the pot make 42 brilliant lights, which burn seven hours. To keep 42 tallow candles, which were formerly used in the manufactory, burning for the same time, required 7lbs. which at 1*s*. per lb. cost	0	7	0
To this add profits on coke and tar	0	1	0
Gained out of every bushel of coal	0	8	0

" 'The gas burners made use of in our manufactory produce jets of flame, which in our business, where much soldering with the blowing-pipe must be done, have a decided superiority over Argand's lamps. We are not nice concerning the quality of the gas—a great part of it is burned from the gasometer, without allowing it to purify itself in the gasometer, because our gasometer is not large enough to store up the whole quantity of gas we want for use.' "

THE following report of a committee of the house of commons, on the subject of coal gas, contains so much important information on the question, that I think it well worth republication in part here: it will tend to obviate many doubts and fears as to the safety and expediency of coal gas lights; and the evidence relating to coke, as applied to the smelting of iron, will by and by be well worth the serious attention of our iron masters, when wood becomes scarce, and iron ore more plenty than fuel. Indeed the great difference between the value of bar iron in England and America, arises chiefly from the greater expense of charcoal of wood over charcoal of coal. At present, (March, 1816) bar iron sells at Birmingham from 9*l.* to 9½*l.* sterling; with us the price is nearly quadruple. Experiments are wanting on the use of anthracite (the Wilkesbarrè and Lehigh coal) for the purpose.

MINUTES OF EVIDENCE

TAKEN BEFORE THE COMMITTEE, TO WHOM THE BILL TO INCORPORATE CERTAIN PERSONS FOR PROCURING COKE, OIL, TAR, PITCH, ASPHALTUM, AMMONIACAL LIQUOR, ESSENTIAL OIL, AND INFLAMMABLE AIR, FROM COAL; AND FOR OTHER PURPOSES; WAS COMMITTED.

Committee on Gas Light and Coke Company's Bill.

Veneris, 5° die Maij, 1809.

Sir James Hall *in the chair.*

THE petition of Mr. Murdock, was read.

Agent for the petitioner,	Mr. James Weston.
Counsel for the bill,	Messrs. Warren and Harrison.
Counsel for the petition,	Mr. Brougham,

Mr. Accum called and examined by Mr. Harrison, counsel for the bill.

I BELIEVE you are a chymist, and have been for some time engaged in assisting the committee in experiments on the consumption of coal?—I have.

State to the committee the process by which coal is decomposed, and the products that are derived from that decomposition.—The coal is submitted to close vessels to the action of the heat of ignition, and by that process these products are obtained.

Will you state the products you allude to?—The products are inflammable gas, tar, pitch, essential oil, and an ammoniacal liquor, and in the distillatory vessel remains behind the well-known substance, coke.

What quantity of coke is produced in proportion to the coal used?—It may be made to increase to double the bulk of the coal.

What is the quantity of coke produced by the decomposition of a chaldron of coals, according to Mr. Winsor's process?—One chaldron of coal will produce one chaldron and three quarters of coke.

Are you speaking of relative quantities by measure?—I am.

Have you made experiments on the coke produced in one of Mr. Winsor's stoves?—I have made them repeatedly.

State to the committee the result of those experiments.—With regard to the coke, I have compared it with other combustible matters usually employed; I have compared it with coal, and from those experiments I have reason to state that the quantity of heat given by a given quantity of coke, if you compare them weight for weight, is as three to one, *provided* the coke has been well prepared; but this must depend greatly upon the nature of the coke produced: if the coke have been well prepared, the proportion I found *usually* was as three to two.

Is the stove made by Mr. Winsor so constructed as to prepare coke of good quality?—It is.

Is it equal or superior to coke made by the ordinary process?—It is superior to that kind of coke which I have hitherto been able to procure in the market.

Now will you state its relative power of producing heat by bulk?—It must depend upon the shape of the coke. If large quantities are given in the form of a cylinder, it must make a material difference than if given in the form of a globe or other shapes; I could certainly say that coke is as three to two, by experiments I have frequently made.

Compare a bushel of coal and a bushel of coke together, and what will be the result?—It would require three bushels of coal to produce the same quantity of heat as is produced by two bushels of coke.

State any experiments you have made to ascertain that fact.—I have taken a measured quantity of water, and I have applied heat to that water by means of coke, until all the water was evaporated. In this way I learnt the quantity of one kind of fuel necessary to evaporate such a given quantity of water as a standard; for a certain quantity of heat is absolutely necessary to produce the effect. I have then made the same experiment with coal, and I found that to evaporate a like quantity of water it required two of coke to three of coal; that is, three bushels of coal to evaporate a given quantity of water, whereas two bushels of coke are only required.

Have you ascertained its quality, by using it in the smelting of ores?—I have.

What is the result of any experiment you have made in smelting, as to the quality of the coke?—I have smelted a given quantity of lead ore, and several other kinds of ore, as ore of copper. I have tried it in ore of iron likewise, and I found that when coke was made use of, instead of common coal, I could effect the process in half the time that I could when coal was employed, and little more than half the quantity of coke was necessary to accomplish my object.

Have you made any experiments with coke made in Mr. Winsor's stove, and coke you have procured in the course of your operations as a chymist, so as to ascertain the relative value of the one and the other?—The coke which I have been able to obtain in the market was of so indifferent a nature, that it hardly could be compared with the coke obtained from Mr. Winsor's stove.

You have no difficulty in saying that the coke obtained from Mr. Winsor's stove is of very superior quality?—It is far superior.

Is a coke fire easily lighted for the use of houses and families?—Equally easy as a coal fire, provided the coke has not been charred too much, or has not been exposed to too intense a heat.

Is it a fire that can be used comfortably and pleasantly in private houses, both for cooking and for use in rooms?—I should have no objection to use it in my own family, and in my own laboratory, and should give the preference on account of less trouble it requires, and its longer duration and intensity of heat.

I believe it produces no smoke?—There is no smoke at all, hardly.

And of course it does not make the same dirt?—Certainly.

Is there any unpleasant smell attending the use of it in private rooms?—None in the coke of Mr. Winsor, but in the coke of commerce there is a considerable sulphureous odour.

Does the coal which is called in the north "slack," which is considered as refuse coal, make coke of good quality?—It answers the purpose exceedingly well, for it is the same substance as the coal, only comminuted, that is, in small particles.

Does the construction of Mr. Winsor's stove produce different kinds of coke?—Coke may be produced according to the will of the proprietor by means of the stove.

But I am asking now if two descriptions of coke, one nearer the fire, and the other further from the action of the fire, are not produced in the ordinary operation of decomposing a quantity of coal for producing gas light?—Certainly there are.

Will you state the difference; whether one is not better for the founder, and the other for private use?—The one kind which is produced, and which has been exposed to a less heat, possesses the property of burning in a pleasant flame, and will therefore answer the purpose of the kitchen for culinary purposes, and wherever a coke fire is required, which is easily lighted, and will yield a pleasant fire. The other, on the contrary, is superior for the purpose of the smelter, for the laboratory, for the furnace, and in all the situations where intense heat is demanded, and particularly if the bellows be applied to assist the combustion of it.

Has the coke made in Mr. Winsor's stove been subjected to the action of the blast-pipe, so as to ascertain if it be fit for all purposes of smelting where the most powerful heat is required?—The fusing of the metallic ores was effected in that manner by means of a blast.

You have stated its relative value with respect to the quantity of heat; I now wish you to state its comparative value with coal, taking the duration of a fire.—I believe this is obvious, from the quantity of heat which is produced, which is as three to two in favour of coke.

Does the same bulk of coke with coal produce a greater heat, or what is the relative duration of a fire made with coke and with coal?—I found in the ordinary way of my housekeeping, when I applied it, that where I light a fire with common coal, it lasted from eight o'clock in the morning till twelve. If the grate were filled with coke, the fire lasted till six in the evening, no attention being paid to the coke; whereas a considerable attention was paid to keeping up a proper combustion of coal.

Was it an equal quantity in both cases?—It was the same quantity. It was as much as could be heaped conveniently in the ordinary way of housekeeping.

Do you happen to know the quantity of coke produced from a given quantity of coal, say a chaldron, in the ordinary way coke is produced; I am not speaking now of Mr. Winsor's stove, but in the common way?—I cannot state any thing to that point.

Mr. Accum called, and examined by Mr. Warren.

What species of coal was it you made use of in the experiments you have spoken of; was it Newcastle coal?—It was Newcastle coal.

Then no experiments were made by you with any other coal than Newcastle coal?—They were not.

Was this coal called slack, or the common ordinary coal?—It was the common coal; the coal in common use.

You have stated, that a given quantity of coal converted into coke will produce more heat than the original quantity of coal itself would have produced; do you mean as to intensity or as to absolute quantity of heat?—I mean to say, that if a given quantity of coal is applied, under certain circumstances, to produce a certain effect, such as the evaporation of water, or the roasting of a piece of meat, the effect produced by such a quantity of coal, when compared with the effect produced by a like quantity of coke applied under the same circumstances, is in favour of the coke, if it be taken by weight, as three to one, or, if it be taken by bulk or measure, as three to two, provided all circumstances are the same.

When you state similar quantities, do you mean weight for weight of coke against coal, or the coke produced from an equal weight of coal?—I mean to say, that if I put on the fire a bushel of coal fifty pounds weight, or any given weight of coal, to warm a room, or to do any other thing, the unavoidable loss which is incurred during the combustion of that coal arises from a portion of the coal passing unburnt through the grate, and mingling with the cinders that are produced; and, further, that a quantity of water is contained in a given quantity of coal; and these are the chief causes of the less production of heat; for a certain quantity of coal thus passes through the grate unburnt: it may be said that it is taken up again and burnt: and I have done so, and I found from experience, after making use of four coal-scuttles of coal, twenty-five *per cent* of loss had been unavoidably incurred.

Which, according to your experiments, will give the greatest quantity of heat, an hundred weight of coal, or that hundred weight of coal when it is made into coke?—It certainly gives more heat before it is converted into coke.

Have you ascertained what would be the weight of one hundred pounds of coal converted into coke in Mr. Winsor's manner?—This may be inferred from the products that are obtained during the conversion of coke. From the one hundred pounds we will deduct thirteen or fourteen pounds per hundred weight, and the remainder will give the quantity by weight.

If coal lose no more than thirteen pounds per hundred weight by being converted into coke, and if, weight for weight, coke yields a greater quantity of heat than coal, in the proportion of three to two, would it not follow, that a given quantity of coal, converted into coke, would give more heat than the coal itself?—The combustion of the coal cannot be effected under the favourable circumstances that coke can; and the way has hitherto been to subject it to investigation by producing the heat in a common grate. The combustion of coal in the ordinary way, in a grate or in a furnace, is exceedingly imperfect; and a considerable quantity of coal escapes combustion, where all the quantity of coke does its duty.

You stated just now, that a fire of coal burning, as I understood you, with equal intensity, would not last so long as one of coke; that is, that if two equal grates were one filled with coal, and the other with coke, and were permitted to burn, giving out an equal quantity of heat, the coke would last from eight till six, while the coal would only last from eight till twelve?—Yes.

Does it not seem to follow from that answer, that the actual quantity of heat given by the coke would exceed the quantity of heat given by the quantity of coal, in the proportion of ten to four?—That is the ratio in round numbers.

You stated just now, that one hundred weight of coal produced a greater heat than one hundred weight of coke; how do you understand that? do you mean it would be more durable, or would it, in itself, contain a greater quantity of heat?—If it could be burnt in the perfect way that coke is, the quantity of heat must be larger, because there is a part of the combustible matter in coal which is lost, and which makes its appearance in the form of a different product during the conversion of coal into coke; but the nature of the coal does not permit that the whole of it should undergo combustion in the grate, or in the furnace, whereas that of the coke does not escape its combustion, or very little of it.

I think you allowed, and do allow still, that one hundred weight of coke burns several hours longer than coal?—It does in the ordinary way.

Is not, therefore, for all practical purposes, one hundred weight of coke more essential in point of heat than one hundred weight of coal?—Certainly it is.

[*An answer given by the witness on a former day was read to him.*]

Be so good as to state in numbers what quantity of water will be evaporated by a given quantity of coal:—That it is impossible for me to do, or perhaps for any body else.

Be so good as to state in numbers the quantity of water which will be evaporated by a given quantity of coke:—To neither of those questions I can give an answer.

If you are unable to answer either of those two questions, in what manner do you draw the inference in the answer stated to the question that was just now read to you?—I draw the inference from the observations I made at the time the experiment was made. I remember perfectly well that the proportion of coal was three to one, but I do not recollect the quantity of water, or the precise quantity of coal necessary, but I remember the result, and do not recollect the precise figures.

Can the witness not state what quantity of water he evaporated with three bushels of coal? I cannot.

Have you any memorandums of the experiments you made? I have.

Do these memorandums show the quantity of water used in the experiment? They do.

Have you got those memorandums with you? I have not; they are in my laboratory; but they may be produced.

But if you had those memorandums, you could answer both the questions I put to you?—I could speak to the quantities.

You have said, that two bushels of coal, converted into coke, produced three of coke, and that two bushels of coke would, in burning, have the effect of three bushels of coal?—I have.

Do you mean to say, that two bushels of coal, when converted into coke, produced the effect of four and a half bushels of coal?—I do not.

You have said, that you made a comparison between Mr. Winsor's coke and that of commerce; I beg to know whence that coke of commerce comes?—I bought it in my neighbourhood, and other samples which I produced myself.

This was from Newcastle coal?—I cannot say that the coal in my laboratory is Newcastle coal, but I have reason to suppose it is; it may be other coal.

Do you then, as a practical man, ascribe the preference to Mr. Winsor's coke to the mode in which it is produced, and not to the intrinsic quality of the coal from which it is made?—In doing this, I must disclose the process of Mr. Winsor, and I beg leave to be informed if I am obliged so to do.

I do mean to ask that, but, without disclosing it, do you consider the preference as owing to the mode of producing it?—I could never produce coke as good as Mr. Winsor's.

You consider the preference to arise from the mode? Probably from the mode of doing it.

You consider the presence of sulphur as in the coke of commerce, and not in Mr. Winsor's coke?—In Mr. Winsor's coke, experience has taught me that there is neither sulphur nor any other matter which I detected in other coke in considerable abundance.

Is there any sulphur, according to your observation, in Newcastle coal?—There is sulphurate of iron, therefore there must be sulphur.

Are you acquainted with Mr. Winsor's method of preparing it?—I am.

Does that method require it to be carried on on a large scale?—It may.

What extent of scale is most advantageous; for instance, now, what size of furnace does it require to do it to the best advantage?—From those experiments which I have seen carried on by Mr. Winsor, I have reason to assert that it may be carried on from a bushel to a hundred bushels.

You say it may be made with a bushel; or with a hundred bushels, but is there any peculiar advantage in doing it on a great scale?—I am not acquainted with the disadvantage in the other mode.

Do you mean in the usual mode?—I am only acquainted with the mode of making coke in the open air, in the vicinity of smelting-houses, and Mr. Winsor's mode is widely different from that.

Have you said, that two bushels of coal will produce three of coke?—It may be made to produce it.

Does it usually produce it in Mr. Winsor's apparatus?—It does.

Whether two bushels of coke so usually given will produce the effect of three bushels of coal?—If the two bushels of coke are burnt in the ordinary way, the heat produced, when compared with a like quantity of coal, although burnt in the ordinary way, is then as three to two, as I stated before.

Do you mean to say, that two bushels of coal, converted into coke, produces the effect of four and a half bushels of coal burnt in the ordinary way?—I do not.

You are aware that the proportion between the coal and the coke is as four and a half to two and a quarter?—In the burning of coal there is an unavoidable loss of coal, which accounts for the want of heat, whereas in coke there is no loss, as all undergoes the burning process.

In the former part of your evidence you stated, that the proportion of effect between coke and coal, in quantity, was as three to two; I wish you to reconcile those different proportions?—I have given no other proportions; the proportions I spoke to were merely approximations. The experiments I made relate simply to the fact, that three bushels of coal produced the effect of evaporating a given quantity of water, whereas the same operation could be produced by one part of coke; but this must vary according to circumstances, if measure be employed; the operation was as three to two in my experiments.

Are you acquainted with the process by which, according to lord Dundonald's method, coal was converted into coke?—No further than as I have read of it in books.

Do you conceive that any great difference, as to value, can exist between the coke prepared in close vessels by lord Dundonald's method, and the coke produced in close vessels by Mr. Winsor's method?—I am not thoroughly acquainted with lord Dundonald's process. It is difficult for me to ascertain that point, but there is perhaps no material difference between the two.

Can you assign any probable reason for a difference?—If I am permitted to disclose the process of Mr. Winsor I can, but I cannot otherwise.

Your evidence is applied to the use of coke in a common fire, and the use you have been describing in smelting?—It is.

You do not mean to apply it to the cases where you use a great quantity of fire, and where the smoke is burnt, and where you wish to surround the whole of the material that you are burning with flame, and where the whole of the coal is put in a state of combustion?—Certainly not.

You have just now been asked as to the relative quality of the coke made in lord Dundonald's stove and that made in Mr. Winsor's, and I think you said the difference might not be very material; would not permitting the gaseous matter to escape, produce an effect upon the manufacture of the coke, so as to make it inferior to that produced by Mr. Winsor?—It certainly might.

That is from the admission of air?—And from other circumstances that might be stated.

Are you acquainted with Mr. Murdock's mode of producing gas?—I am, as it is before the public. The process has been laid before the Royal Society.

Do you conceive (without disclosing the details of either of them) that Mr. Winsor's is greatly and generally superior?—I do.

Mr. George Bramstone Bridges called, and examined by Mr. Harrison.

I believe you have frequently superintended the decomposition of coal in Mr. Winsor's stove? I have.

Will you state what is the average quantity of coke produced from a given quantity of coal; a chaldron for instance? From an experiment at which I was present all the while, (for I saw the coal put in, and waited till the coke was drawn from the stove,) there were three bushels of coal put in, which weighed two hundred and fifty-six pounds, and it produced five and a half bushels good coke, good measure.

Did you carry a quantity of coke manufactured in one of Mr. Winsor's stoves, into Surrey, to Joseph's iron-foundery? I did; two sacks.

And delivered it to a person of the name of David Walker? To David Walker, the foreman of the forge at Joseph's foundery.

Where does Walker live? When he is with his family, he lives in Narrow-walk; but he is foreman to Mr. Joseph's forge, on Morris' Causeway.

John Patteson, esq. (a member) examined by Mr. Harrison.

What is the quantity of coke you have produced for your own use? I have found that four bushels of coal produced five of coke, and I can give the particulars of the quantity. I found, that one hundred and twenty chaldrons of coal produced one hundred and fifty-three and a half chaldrons of coke, that was in one year; and in another year, I found that one hundred and twenty-five chaldrons of coals produced one hundred and sixty chaldrons of coke, which is about the proportion of one-fourth increase; but I know nothing of the weight.

I believe you also know that coke is always estimated by measure, and not by weight? By measure always. I should observe also, that the operation of burning was in an open oven.

On what species of coal was your experiment made? From Newcastle coal, called South Moor.

David Walker called, and examined by Mr. Warren.

What are you? I am foreman in the foundery line, and melt the iron down for the moulds with coke.

At Mr. Thomas Joseph's, of Morris' Causeway, Lambeth? I am.

Did your master employ much coke? He burns as much coke as any in London.

Does he melt twenty tons of iron a week? Yes, he does.

So that you have had great experience in the quality of coke? Yes; ever since I was fourteen years of age; and now I am thirty-six.

That is twenty-two years? It is.

Does your master prepare his own coke? Yes.

In what way does he prepare it, in a close oven, or in an open oven? In an open oven; open at the mouth only, being covered at the top with a flue, which lets the air out.

The air can get at it? The air can get at it and out of it.

What do you call the furnace in which the iron is refined? A blast-furnace.

And is brass reduced in the same way? Yes; and the greatest part of the iron in my master's foundery is reduced by a blast-furnace.

Have you made any experiments on reducing iron with coke made in Mr. Winsor's stove? Yes; Mr. Bridges was the gentleman who brought the coke there; and he asked me if I would try the coke, whether it would melt iron.

How much coke was brought by Mr. Bridges? A couple of sacks.

Did you apply that in reducing the iron? I took and put all my master's light out of the furnace, and took that only, and put in what we call so many charges; and it brought it down in ten minutes or a quarter of an hour sooner than our own coke did.

Can you state what time your master's coke generally takes in reducing the iron? I cannot tell within five or six minutes; but I can tell within ten minutes; and I think it is about an hour; and this of Mr. Winsor's was about fifty-five minutes, as near as I can tell. There was about five or ten minutes difference.

Did you try it more than once?—Yes; three times.

In a blast furnace?—Yes; in the same blast furnace.

Will you state to the committee, whether the coke that is required to be used in a blast furnace must be strong?—It is required to be of more strength than other coke, in our furnace, because it is blown by an engine of greater force; and if it was not strong it would not stand the blast.

This coke did stand the blast in reducing the iron sooner than your master's coke?—Yes.

Did you use the same quantity of Mr. Winsor's coke as you did of your master's?—I did, equally the same quantity.

You say this experiment was tried three times; was the result always the same, that is, did it always reduce it from five to ten minutes sooner than your master's?—The last time I tried it, I could be faithful and upon oath, but I was not quite certain before, and that was the reason I had it brought to try it again, that I might be convinced.

Was the iron so reduced as good iron as is used to be produced by your master's coke?—It is as good, and was rather hotter than usual.

Are you satisfied, upon the whole, that Mr. Winsor's coke is better than your master's?—It is as good, and was rather hotter than usual.

How do you know it gives more heat?—I can tell it from experiments with their coke and with our coke, and I can tell by the metal.

From what coal is your master's coke produced? —It comes up the river, and is called Newcastle; it is no other coal than the common coal.

Can you tell when your master burns a certain number of bushels of coal, how much coke he gets? I can tell what they allow for it: we say that one chaldron and a half of coals will produce two and a half of coke, or very near, but I cannot swear to that, but it is what they allow to it.

When you tried the experiment of the coke, I wish to be informed if you tried it by measure or by weight? By measure.

Have you any reason to suppose that the weight of the two articles would have been as different as the measure, if you had weighed them?—I do not know how much it may weigh, so that I cannot answer to that; but coke is never weighed.

Was the iron that was smelted by Mr. Winsor's coke more liquid than that smelted by your master's coke?—It was rather hotter than our master's in general; it was warmer, and went into the mould better; it would run through the eye of a needle; it was thinner.

What do you mean by hotter?—It was quicker to run.

It would pour out easier?—Yes, it was more fluid; it would run into the moulds more fluidly.

Of course it is the better for that?—Yes, if it was thick it would not make the goods, and would be all lost.

Did you ever superintend the making of coke in your master's foundery?—I never made any coke myself.

Then how do you know what quantity of coke is produced from a chaldron of coal in your master's foundery?—I do not know it, only what I have heard them say.

You say you made three experiments with the coke from Mr. Windsor's, and in the last experiment you can take your oath as to the effect produced; I wish to know what was the exact effect produced in the third of those experiments?—

The reason I tried it so exact was to be certain: I measured so much coke, and I knocked out all the fire that was in the furnace, to convince myself, so that I could safely say that that coke had melted the iron, and nothing but that coke.

In how many minutes was that iron melted?—In about fifty-five minutes.

Did you ever know your master's coke melt it so quickly as that?—No; I never did.

What is the quickest you ever knew your master's coke melt it?—About an hour; our common charges, what we call two hundred or two and a half hundred at a time, take a good hour, and this takes fifty-five minutes, or rather less, but I call it that; but I could safely say that it was five or ten minutes sooner than our master's coke.

On the whole then it was thinner by this coke of Mr. Winsor's, and in a better state to make the different articles?—It was in a better state.

Than was ever produced by your master's coke? —Yes.

Would you venture, if it was your own trade, to give more money for a bushel of Mr. Winsor's coke, than for a bushel of your master's?—If I had the business in my own hands, I certainly would.

Whether the coke of your master was made from the best Newcastle coal?—I do not know; but I believe it was from the common Newcastle coal.

Mr. Accum called, and examined by the committee.

You said, that, in comparing lord Dundonald's method and Mr. Winsor's method, you were not aware whether the gaseous matters were allowed to escape; now I ask you, whether it would make any difference at all if the gaseous matters were permitted to fly off in waste, or to receive them in receivers, would it not have the same effect?—Experience has convinced me of the contrary; not merely the circumstance of collecting them, but also the mode of receiving them.

I wish to confine myself to the mode of collecting them, because that is the only difference between lord Dundonald's and Mr. Winsor's plans, and that appears to me to be one and the same thing. I think it can make no material difference with regard to the coke, either collecting them or dissipating them.

Examined by Mr. Harrison.

What is the quantity of tar produced by a chaldron of coals?—That must vary according to the nature of the coal; but I found from experiments that one hundred pounds of coal yield from four to five pounds of tar.

Of what quality is that tar?—It is of the consistence of treacle, or of a thick oil.

Have you decomposed that tar?—I have made some experiments with it.

Will you state the result of those experiments, and what products you obtained?—The tar yields a certain quantity of volatile oil, and a residuary matter, in a substance resembling asphaltum; asphaltum is one of the products obtained by the simple distillation of the tar.

What quantity of essential oil and asphaltum did you obtain?—It is according to the nature of product to be procured.

But I am speaking now about the average quantity of the two products—I obtained from a chaldron of coal sixty pounds of pitch, and about thirty pounds of essential oil, that is, about three gallons.

That is over and above the pitch?—Yes.

Both, you say, from a chaldron of coals?—I did.

Was that of good quality?—As far as I could judge, very good.

Have you tried any experiments on that pitch to obtain asphaltum?—I did.

Did you procure asphaltum?—I did.

Of what quality was that asphaltum which you procured?—It answered all the purposes of the asphaltum procured in the market. I have given it to japanners, and have seen specimens of what it produced, and it looked very beautiful. I have dissolved it in turpentine to procure a varnish, and it will bear an excellent polish: asphaltum is chiefly employed by varnish-makers and japanners.

What is the quantity of asphaltum?—It varies considerably, according to the nature of the pitch.

You are not able to state any average quantity? —You may say half, at an average.

That is, sixty pounds of pitch produce thirty pounds of asphaltum?—Yes, thirty pounds.

In performing the process of getting the asphaltum from the pitch, do you not procure an additional quantity of the essential oil?—I do.

What additional quantity of essential oil do you get in turning the pitch into asphaltum?—It is according to the nature of the pitch.

State some average quantity?—About twenty-five per cent. upon the quantity.

Was this twenty-five per cent. an additional quantity of essential oil upon the original quantity of pitch?—It was after the tar had been so far evaporated until it came to the consistence of pitch; and continuing the operation further, an additional quantity of essential oil must be obtained.

Then do I understand you, that this sixty pounds will produce thirty pounds of asphaltum, and fifteen pounds of essential oil?—Upon an average it does.

Is this operation carried on by Mr. Winsor, or is it a separate thing?—Not that I know of; I am unacquainted with the operations carried on by Mr. Winsor.

You have stated, in your first answer to me, the products obtained from a chaldron of coals; now this last product of tar from which you obtained the essential oil and pitch, has that been obtained from the product taken from one of Mr. Winsor's stoves, and the experiment made by himself?—Entirely.

Is asphaltum of good quality a thing easily to be obtained now?—It only requires boiling; that is the process.

I believe the asphaltum generally used is imported from abroad?—It is imported from abroad.

Is it easy to procure it now?—The situation of the continent has raised the price to four times what it was. It used to be about fifty-six shillings per hundred weight, and now it is one shilling and six-pence per pound, as far as I have been able to learn the market price.

Where was the asphaltum generally brought from?—I believe from the Dead Sea.

From the Mediterranean and the Levant?—Yes.

Examined by the committee.

Whether the quality of this asphaltum is as good as that usually imported?—I think it is superior, for it bears a better polish. It may be completely reduced to powder, which the other cannot. It will bear an excellent polish, which cannot be done by the asphaltum in the market.

What is the quantity of ammoniacal liquor obtained from a chaldron of coal?—It is one hundred and eighty pounds on an average, or eighteen gallons.

Am I to understand you, that all these products are obtained from the same chaldron of coals?—They are.

That is, from the chaldron of coals in the first place you produce the coke?—Yes.

And also the quantity of pitch?—I do.

And the essential oil?—Yes.

And the quantity you have given of ammoniacal liquor?—Yes; and the asphaltum.

All these products you have been describing, are procured in the process of making the gas?—They are.

That is, the very same process which makes the gas leaves these products?—Yes.

What quantity of tar is procured from a chaldron of coal?—From four to five pounds in the hundred weight; but I am unacquainted with the weight of a chaldron of coals.

Then if another process is performed upon that tar, you produce then from a chaldron of coals sixty pounds of pitch, and thirty pounds of essential oil?—Yes.

And if you boil that pitch still further, and reduce it to one half, or thirty pounds of asphaltum, you obtain an additional quantity of essential oil?—Yes, I do.

Is that additional quantity better or worse?—It depends upon what it is intended for.

Is it essential oil which may be made use of for various purposes?—Yes.

You have read of lord Dundonald's process; does it consist, with your knowledge of the subject, that the results of pitch and tar and ammoniacal liquor differ in any respect in Mr. Winsor's process from lord Dundonald's?—If I mistake not, lord Dundonald only states tar, but does not mention essential oil.

Mr. Accum, called and examined by Mr. Warren, for the purpose of explaining a part of the evidence given by him on Monday the 8th of May.

The following questions and answers were read to the witness:

You have said, that two bushels of coal converted into coke produced three of coke; and that two bushels of coke in burning would have the effect of three bushels of coal?—I have.

Do you mean to say, that two bushels of coal, when converted into coke, produced the effect of four and a half bushels of coal?—I do not.

Mr. Warren then put the following question to the witness.

Do you wish to explain that answer, "I do not?" —I wish to say that I do not mean as a general or universal proposition, but I do as used in the way I have described, because it is not where the whole of the coal can be made to do its duty, where no part of the coal can escape combustion, or where the coal can be burnt completely, which was not the case in the experiments which I spoke of.

Have you any thing to add to the answer you made concerning the price of asphaltum?—It used to be about 50*s.* per hundred weight, and now it is from 1*s.* 6*d.* to 2*s.* per pound.

Is there any thing you wish to correct or add to the answers given by you as to the quantity of coke produced from a given quantity of coal?—The quantity I obtained, and which I stated to have obtained, may remain as it is: but I wish to add that I have seen coal converted into coke by others, and that from one chaldron of coal a chaldron and three fourths of coke was obtained.

That was at Mr. Winsor's furnace?—It was.

You were present?—I was.

Will you state the accuracy with which that experiment was made?---The measured quantity of coal being introduced into the apparatus, the apparatus was sealed by some gentleman present, and the process was carried on afterwards. I was called upon again, to see the re-opening of the furnace; I examined the seals, and found that they had not been violated. The coke being discharged from the furnace, it was measured in my presence, and in the presence of several others, and yielded the quantity I have stated; viz. seventy-five per hundred weight increase upon the coal introduced into the furnace.

I believe Mr. Pedder was present at the time? I recollect Mr. Pedder's face.

Mr. Thomas Dalton called, and examined by Mr. Warren.

WHAT is your situation and business? I am foreman caulker to Messrs. Wells, Wigram, and Green. This firm took place in this year.

They are ship-builders in Mr. Perry's yard?—Yes, they are.

Have you been employed by them or any other persons long in the business? Not only by the late, but by the present firm, for twenty-six years last Saturday.

Of course you have made observations on the bad or good qualities of tar and pitch? Certainly I have.

Was a quantity of tar or pitch delivered to you at any time by Mr. Bridges? Both.

Did you make any experiments with that tar? I did.

In what way did you use it? I tried the pitch upon an oak board, and upon fir, and I found it to answer every end that the common pitch which we use in our yard does.

Did you use this pitch in caulking in the same way as the common pitch is used? In the same manner as we use the common pitch in our yard.

State from your observation whether it could be safely and properly applied to shipping? As far as my judgment goes, I can answer this, that I think it superior to any pitch I have used in our yard, ever since I have been in that yard, for these twenty-six years. That paper you see there I believe has been under water forty-eight hours, and that piece of paper is payed with the tar coal as I received it from Mr. Bridges.

And it has been under water forty-eight hours?— It was payed on Saturday morning at ten o'clock and was put under water, and on Monday morning at eight o'clock I took it out.

What has the pitch been which you have been in the habit of using for these twenty-six years? Foreign pitch.

Brought chiefly from whence? I judge chiefly from Sweden.

And you think this is as good? In my own judgment I should give it the preference.

Why should you give it the preference? In the first place, in respect to its colour; but perhaps it is impossible for me to state all the reasons here to gentlemen who have not been in the habit of seeing it used.

But what do you mean by its being better in colour?----It is blacker; and the captains and owners of ships wish to have their vessels with a beautiful glossy black, and I have got scolded when it has been otherwise; it is a very great article in the look of it.

Have you used it cold? It is impossible to use pitch cold.

But with respect to the tar? With respect to the tar, it can be used cold, for the purpose of paying ships, as well as hot; if you turn the boards you will find, that some of them are payed cold and some are payed hot.

Then I understand you to say, with this tar you can pay cold? Yes.

With other tar can you pay cold? It cannot be done at all.

Are you a man of science enough to know from what that difference arises? I fear I shall not be able to explain it.

But is it so in fact? It is, from experiments. We use a paper of a thick substance commonly, but there is a paper generally used double, which is not one third so thick; this thick paper is used single, and that paper is dipped into the barrel of tar boiled, and into every barrel of tar we put six gallons of train oil to make it thin; this will not stick together, dipped in that tar, and it will dry in about six hours.

Then the tar brought to you by Mr. Bridges may be used without oil? Yes, and without fire.

But the other tar requires both fire and oil?----It can be used without fire or oil, but not in the regular way; but to dip paper in the usual way, as we do ten or twenty reams a day, it is impossible for it to be done.

When you use this tar is there any oil upon the surface? There is.

In your judgment, do you consider that an advantage? It is, as far as my own opinion goes; and while there is oil on the surface it nourishes the boards, and being dipped on both sides it is a nourishment both to the outside and to the inside. This was payed by myself on last Saturday, and payed cold.

What is the present market price of pitch and tar? —The present market price of pitch and tar, by the last which I received on account of my masters, was 28*s.* per hundred weight; but I will not be positive as to that.

But as to tar, what is the price of that? I have received no tar these two years.

Is there a great demand for pitch at present?—I suppose there is; we use from three hundred to four hundred barrels a year, I mean in our concern of Wells, Wigram, & Co.

Is the supply as plentiful as it was some years ago? I know no scarcity there, because if it is ever so dear it must be had.

What was the price of this ingredient nine or ten years back? It was 14*s.* per hundred weight.

So that in the space of the last ten years it has doubled?----In the space of four years it has doubled.

As to pitch, you mean? I am speaking of pitch.

Those experiments you have been talking of were made upon the materials brought to you by Mr. Bridges? Yes, they were, and upon no other but that pitch and tar, and that only.

And these are the boards? Those are the boards. But as it respects the circumstance of pitch, it is impossible to say, as so many captains and owners are of so many minds; but with Mr. Winsor's I should get a great deal of credit, because it will do so well.

Are you able to speak to the benefit of the tar as a covering for wood, to protect it against the climate?—I consider it a very good thing for any climate.

You mean that particular tar? This particular tar.

[*A board and paper payed with common tar was handed to the witness.*]

Is this the common tar? This is the common tar.

Is that what you mean? This is the common tar which we use in common; there is neither colour nor substance in it.

Which is the tar Mr. Bridges brought? That is the tar Mr. Bridges brought.

That light coloured tar is, what? This is the common tar payed cold, and this is Mr. Winsor's tar, payed cold; this is Mr. Winsor's tar payed hot, and this is the common tar payed the same. Look at the back of the paper, and you will see that it has gone through totally, but the common tar has not gone through at all.

Is it any benefit to have the power of penetrating? There is not a doubt of it.

The further it goes in, then, the better? Certaintainly; it was quite through in three hours.

Cross-examined by Mr. Brougham.

In the course of your employment, for the last twenty-six years you have mentioned, have you ever been in the habit of using the tar purchased of the British Tar Company? I do not recollect the name; do you mean the tar extracted from coal?

I mean the tar extracted from coal. I have; a great deal of it.

Was it extracted, as far as you know, by the process of Lord Dundonald? I do not know.

Where was it purchased? I do not know.

Do you know where it was got from? I do not.

How long is it since the tar extracted from coal was used by you? If I had my book I could tell you, but it may be two years ago; I received twelve barrels of it frem Birch, Wright, & Co. of Limehouse; I think that was the firm.

Examined by the Committee.

You said that foreign pitch was 28*s*. per hundred weight? I did not state that positively, for I cannot be accountable for it; I have received no pitch since the 24th January last.

You do not know if it is not a great deal dearer now? It may be.

How much do you suppose? I cannot tell; I never troubled my head about that; the quantity I received in January was thirty barrels; I was not correct in the sum, nor did I pretend to be so.

You have said that you made use of coal tar formerly? Yes, I have, under the name of coal tar, some quantities.

Comparing the coal tar you formerly used and that lately obtained by Mr. Winsor, are they of equal quality, or is Mr. Winsor's superior? The first coal tar I used was twenty years ago; I was then employed, with two other servants, to boil that tar down, and in so doing we were obliged to use a considerable quantity of something, but what, I cannot tell, to keep it from rising over.

Will you go on to state the comparison between the former coal tar you used and that produced by Mr. Winsor? The comparison is in favour of Mr. Winsor's; his is preferable considerably; but it is impossible to state the difference, unless gentlemen were to see it themselves.

You say that you used something to prevent it boiling over; is that a secret, or cannot you explain it?—It is no secret; it was sent by the person that sent the tar; I was a servant then, and had served six years of my time, and was employed to boil it down with another, and we were obliged to put in what I believe was bird-lime, but I cannot speak exactly; the tar of Mr. Winsor will not rise.

You mentioned, that you used coal tar two years ago; what was the quality of that?—It was in a better state than the first.

But, compared with Mr. Winsor's, how was it?—It could not be used without fire, and would not bear to dip paper without oil.

Mr. Philip Overton called, and examined by Mr. Harrison.

Where do you live? In Paul-street, Finsbury-square.

What are you? A japanner and ironmonger.

Have you seen any tar that came from the stove of Mr. Winsor?—I did, I waited there three or four hours.

Did you see that tar evaporated and converted into asphaltum?—Yes, I did.

Did you make use of that asphaltum in japanning?—Yes, I did; I japanned these two articles.

Of what quality was that asphaltum?—It was a superior black to what we use.

In what respect is it superior?—It is blacker, and I think it dissolves quicker.

Does it dry well?—It dries uncommonly well.

From your judgment as a japanner, is it of a quality perfectly fit for your business, and which will last? —I do think it is.

What asphaltum have you been in the habit of using?—Various asphaltums, but the foreign is the best; I believe it comes from Russia, but I will not be certain.

Is the asphaltum that you saw from this tar made at Mr Windsor's stove, of equal or superior quality to the foreign asphaltum you have been able to procure? —I am sure it is equal, and think it is rather better, but making so small a sample one is not so well able to judge; if we made more, we could tell better than only by two or three articles.

Is that to the advantage or to the disadvantage of the experiment?—It a very great disadvantage.

What is about the average price of asphaltum in time of peace?—In time of peace I cannot recollect; but I recollect the peace in 1802, but that made very little difference in the price of asphaltum.

What is the present price you pay for it?—I have given as much as 5*s*. per pound.

Is good foreign asphaltum easily procured upon any terms?—I do not think it is to be got in London or in England.

What do you mix the asphaltum with, for the purpose of japanning?—It is boiled in linseed oil.

Is there any resin?—Yes.

What is the use of the resin?—It will cause it to flow and dry quick.

Did you mix this in the usual way?—This was mixed with resin, and this without: it can be done without resin.

Did the asphaltum answer in both modes of using it?—It did.

Are you satisfied, from the experiments you made upon it, that it is perfectly fit for the purposes of trade? —I am; I have shown it to several of the trade.

Cross examined by Mr. Brougham.

Have you ever used the asphaltum made by the British Tar Company?—No; I do not think it can be used.

Did you ever see any of it?—Never.

Then I presume you have made no experiments to show that it cannot be used?—No; I have made none.

Then you cannot tell if it can be used?—I cannot tell; but I should suppose it could not, or there would not have been any scarcity. We have been obliged to go all over London for it.

Examined by the Committee.

When you speak of foreign asphaltum, what do you mean to distinguish; is there any such thing as home asphaltum?—I have seen what they call British asphaltum, but it does not answer the purpose.

What is it made from?—I cannot tell, but that it is dear, and it does not dissolve so well as foreign.

And will not that answer for japanning? It will not, for best work; but it might answer for common things.

The witness has used some asphaltum produced by Mr. Windsor? Yes, I have.

Did you fetch it yourself from Mr. Windsor's? Yes, I did.

And saw it made? Yes, I did.

You know nothing of British asphaltum? I know that it does not answer the purpose.

Have you ever tried it? I have got a hundred weight in my house, and should be very glad to sell it for what I gave for it.

You did not mean by British asphaltum, Mr. Winsor's? No, I did not.

How long is it since you made the experiments with Mr. Winsor's? This was done the week before last.

Have you ever tried it before, on any other articles? This was done first.

When was that done? I believe about a fortnight before the other; this was a month or six weeks before.

Had you tried it before that, on any other articles? Not before that; but I have tried it on other articles since.

Mr. Benjamin Cale called, and examined by Mr. Warren.

I believe you live in Charles-street, Tottenham Court Road? Yes, I do; and am a japanner.

Have you used some of the asphaltum brought you by Mr. Bridges? Mr. Bridges, just about five weeks ago, brought me some asphaltum, or a substitute for it. I used it, and I think, in my own opinion, it is equally as good as the foreign, if properly used and managed. I have used hundred weights of foreign, and of substitutes for it, before Mr. Windsor applied to me. His melts better, and in the foreign asphaltum, of which I have used many hundred weight, at the bottom of the vessel where the varnish is put there is a vast quantity of sediment, which is thick and glutinous. I have tried a gallon of Mr. Windsor's, which is but a small process, but the effect is just the same; and it dissolves better in the varnish, and does not leave that bottom.

Is that the gentleman that brought it to you? That is the gentleman; and, in short, I have got a part of what he brought me in my pocket. I have been a varnish-maker these twenty-nine years in London.

You think it is as good as the foreign asphaltum? I think it will answer equally as well, and there will not be that bottom.

I omit the evidence of Mr. W. Bryan a silk dyer, as to the use of ammoniacal liquor in producing drab colours on silk and woollen; the examination of Mr. Cole, as to the use of it in agriculture; the examination of Mr. Accum as to its value for carbonet of ammoniac, and sal ammoniac, for painting, and as a substitute for oil of turpentine, because although the products of distilled coal *may be* converted to these purposes, it can never be worth the while of the gas manufacturer to engage in so many branches of business. To him, the only inquiry is, "can I sell my tar, and my alkaline liquor? to whom? and at what price?" If he cannot sell them, he had better throw them away. As to the coke, there can be no doubt of its meeting with ready sale; and that the demand will daily increase as its value becomes known.

Mr. Joseph Kaye called, and examined by Mr. Warren.

You are a surveyor?—I am.

Where do you live?—In Bedford-street, Bedford-square.

Have you been long employed in the business of a surveyor?—It is my profession; I have been in the profession on my own account for five years.

Have you been applied to by any persons to make a plan of the parish of St. James, or to calculate the expense at which it might be lighted by gas? I have.

Have you got that plan with you? I have.

[*The witness here produced the Plan.*]

Is this an accurate plan of St. James's? It is.

Where is it taken from? It is taken partly from accurate documents in my possession, and partly from actual admeasurement.

Do you believe it, on the whole, to be an accurate plan of the streets in the parish of St. James? I believe it to be accurate.

Sufficiently accurate for the purpose? Yes, sufficiently accurate.

Have you any calculation of the number of miles that the pipes are to go, backward and forward? I think the whole length of the main pipe amounts to sixty-five thousand five hundred feet, or between thirteen and fourteen miles.

Upon what scale is this plan made? It is made upon the scale of about seventy feet to an inch. The scale is annexed to the plan.

Whereabouts is Mr. Winsor's station. That is it, is it? Yes, it is.

Now, I observe, that there are in different parts of this plan, six red spots, called stations? There are.

What are we to understand by stations; is it a place where you suppose there is to be one or more stoves? It is.

To what length has Mr. Winsor's pipe carried the gas, in the direction towards the palace, from his station? I am not prepared to say; but it may be easily ascertained from the scale. I have compasses in my pocket, and will estimate it.

What is the distance? The length of the pipe in Pall-Mall, as near as I can ascertain from that plan, is one thousand seven hundred feet.

But do you understand that there are pipes on both sides of the street? I have taken it only on one side; I have taken it the whole length of the south-side of Pall-Mall.

What is the length of the pipe from Mr. Winsor's station, measuring it in the direction from that station, to St. James's Palace? I should think about one thousand feet.

Where did you measure that from, not from the inside of the house? I have allowed about one hundred feet from the stove to the pipe; I could not state it exactly, or take upon myself to say that it is accurate.

Then that, added to the other, makes a thousand feet? About one thousand feet.

Have you measured the distance between this station, between Duke's-court and Great Ryder-street, and Mr. Winsor's station? I have not particularly.

Be so good as to measure it; what is the distance? Measuring it along the line of the streets, it is one thousand three hundred feet nearly.

Can you state that each of these stations is within a distance of two thousand feet from the station next to it? I can. I am speaking now in direct lines; I never tried it through the streets.

Have you made any estimate of the expense of carrying pipes in the direction marked out in the stations? I have.

Have you got it about you? I have.

[*The witness produced it.*]

Have you it in your hand? I have.

What do you make it amount to?

[*The witness here read the paper alluded to.*]

Is twenty-five per cent. for wear and tear on the stoves, a fair allowance? I think it is a handsome allowance.

On the pipes two and a half per cent.? I think that is a full allowance.

Is two and a half per cent. on posts and burners fair? That is quite sufficient.

Is 3*l.* 3*s.* a reasonable allowance for the labour at each station per week, and the number of men to be employed? I do not feel myself a competent judge whether it is or not.

[*Mr. Warren here read an extract from the return under the population act.*]

In St. James's	- inhabited houses	3,430
In the whole of Westminster	-	18,231
In the whole of the cities of London and Westminster	- - -	121,229
		142,890

If two men and a boy are employed at each station, is 3*l.* 3*s*, per week sufficient for their labour? More than sufficient.

What will be the probable amount of the rent of such a house as may be proper to erect on these stations; is 60*l.* a year too much? Taking one with the other, I should suppose 60*l.* a year must be a fair allowance.

Do you know the usual price at which lamps are lighted in the streets? I mean the common street lamps? The common street lamps I understand to be lighted at about the price of 1*l.* 5*s.* per annum.

How many lamps are there in St. James's parish; we have got two thousand two hundred? That number is nearly accurate, exclusive of St. James's square, which is a separate trust.

Is this taking any thing but the common lamps, or does it include the gentlemen's lamps? It includes none but the parish lamps.

And does not include private lamps? No, it does not.

Cross-examined by Mr. Brougham.

You have said here, that the expense of adapting the house for the reception of the stove, for its becoming a station, might be about 500*l.* each? I did.

Do you mean to say that that is upon the supposition that these repairs only are required for the purpose of adapting this house, and which you have been informed by Mr. Winsor's committee are necessary? I had a general description given me, from Mr. Winsor's committee, of the space they were likely to want for the purpose of carrying on their works; and from the best judgment I could form of the circumstances that might be attendant upon the situation they were likely to find, I considered that 500*l.* might probably be sufficient to adapt the place for such an object. One must always speak with some degree of uncertainty, as it would entirely depend upon the sort of property they were enabled to procure for that purpose.

Mr. Winsor's committee also stated to you, to enable you to make the estimate, the precise nature of the repairs which would be occasioned? In general terms only.

And upon their statement you made the estimate of 500*l.*? Yes; on their statement, and from my own judgment.

From your own judgment, proceeding from their statement, you made the estimate? Certainly.

You have said that 60*l.* might be a fair rent for the house in each situation? I did not consider it necessary in all cases to take a house.

You said that 60*l.* might be a fair rent at each situation where a house might be taken? I beg leave to correct the word house; I mean building.

Was it upon the statement of Mr. Winsor's committee, respecting the nature of the building, that you formed that estimate? It was.

You do not know if a man and two boys would be enough in each situation? I do not know from my own knowledge, but I should think it would.

Examined by the committee.

By the estimate of 24,000*l.* do they propose to light both sides of the street, or only one? The lamps are described upon that plan. In the narrow streets the distances are measured diagonally, and in the broad streets they are measured by straight lines, on both sides of the streets.

Does it appear, by the plan, in what cases it is intended to light both sides of the street, and in what cases it is intended only to light one? In all cases both sides of the tsreet are to be lighted; but the lamps are placed alternately, in the narrow streets.

Can you tell what proportion of light they will give to the present? I am not sufficiently scientific to do it.

Whether the number of lamps are marked on the map, which are supposed to be wanted upon this new scheme? They are marked on the plan.

Do you happen to recollect what the number is? It is about eight hundred.

Then your calculations are made upon eight hundred burners? They are.

What is the distance from each of the burners? About seventy feet.

Do you mean that the distance is the same where the streets are regularly lighted on both sides, or where they are lighted alternately? As near as possible the same; but in dividing them, attention has been paid in nearly all cases to place the lamps at the angles of the street.

We will take a narrow street, where the lamps are placed diagonally or alternately; do you mean to say that those lamps which run, for instance, upon the north side of the street, are placed at no longer distance than seventy feet from each other? If you measure on the north side of the street, they are, but not if you measure diagonally; that is the principle upon which the plan is divided.

Do you recollect, or have you reason to know, what distance asunder the present parish lamps are? From thirty to forty feet.

That is about one half the distance proposed in your plan? I never made an estimate of it accurately, but they are in some degree divided by the circumstances of the buildings; and that must be the same in all modes of lighting in some degree.

You mention, in estimating the expense of the pipes, that they should be three inches diameter; do you mean that the whole pipe, from the station to the extremity, out and out, would be the same size; would they not be smaller at the extremity than near the station? I have considered them as three inches diameter universally.

Would it not be more convenient to make them larger near the fountain head, and so to diminish towards the end? I apprehend not; from the number of ramifications there necessarily will be from the main pipe, there will be the same necessity for the pipe continuing the same size throughout as at the commencement.

Of what material is the pipe, of which you have given the estimate, to be made? Iron.

Cast iron, or wrought iron? The price would furnish a cast iron pipe at 3*s.* a foot, for a pipe three inches in diameter.

Would it furnish wrought iron too? Yes, at a much less expense.

Mr. Accum called, and examined by Mr. Warren.

Have you been employed in making experiments on the extraction of gas, or inflammable air? Yes.

For how long? About six months; though I have made experiments for Mr. Winsor's committee twelve months ago.

Have you seen it made by Mr. Winsor, and by his stove? Yes.

And seen the effect produced by this gas? I have.

May it be conveyed through pipes? Yes, like any other fluid, through pipes, from place to place.

Supposing there is an aperture made in the pipes, at a given distance, and the inflammable air issues out of it, if a candle be applied to it, will it take fire? It will take fire.

And will it continue burning as long as there is a fresh supply of inflammable air? Yes, it will.

Will it burn without coming in contact with the common air, or the union of hydrogene and oxygene? It is impossible for it to take fire, unless it communicates with the external air; it cannot take fire spontaneously.

Have you made any experiments upon the elasticity of the gas? I have.

Can you state, from your experiments, to what distance it will flow? I cannot state any thing to that fact; but from what is known, and what is before the public, from the results of a gentleman who ranks very high in the field of science, I can state my opinion, on the confidence that gentleman deserves.

It is your opinion I am asking for now, as to the elasticity of the gas? We know that it has flowed for miles, as Mr. Murdock has informed the public, in a circuitous rout, and therefore we have reason to suppose it would flow to a greater distance.

Is it stated, in the work to which you allude, that it flows from its own elasticity or by any force applied to it? It flows as all other fluids do, though assisted by the rarification it undergoes; by its elasticity it will flow upwards, which other fluids cannot do.

Is there any smell in the gas, at the time of the combustion? None, if the combustion is properly effected.

Have you seen experiments made to try if it leaves any smoke, by placing it under a glass? Not at all.

How long has that experiment been made? For twenty-four hours.

And no soot produced? Nor smoke, if proper arrangements are made.

If a candle had been put under a glass, would there not have been soot in a considerable quantity? Undoubtedly.

Is there any danger of this gas bursting the pipe in which it is contained? Not in the manner I have seen it generated by Mr. Winsor, and conducted through the pipes constucted by him.

In what way must it be used to make any danger. Suppose there is a large reservoir or gas meter? If more gas is liberated than could escape through an opening, there would be danger of bursting.

That would not arise from the construction of the pipes by Mr. Winsor? If there was no reservoir the gas could not accumulate; and all the quantity of gas is not at liberty to pass through the apertures.

But there is no reservoir in Mr. Winsor's plan? None.

The pipes contain the gas without a reservoir? They do.

Have you made any experiments upon the intensity of this light, or the quantity of light which it gives? I have, both.

Have you compared the light produced by a flame of gas, with the light produced by an equal flame of a tallow candle? I have.

First state the way in which you brought the flames to an equal size? I constructed an apparatus, with perforations which permitted the gas to flow through it in such quantities only that when set on fire the flame thus produced measured, as near as could possibly be ascertained, the same size as that afforded by another luminous body, a candle, I made use of, which was given as a standard.

That was the plan you adopted? It was; and the same experiment I have made with Mr. Winsor's apparatus.

What experiment did you then make, to ascertain the quantity of light produced? In order to obtain some knowledge of the respective intensities of the two lights, it may be accomplished by judging of the intensity of the shadows which these bodies cast when they are suffered to fall with a certain obliquity upon an illuminated surface.

That is what is called count Rumford's experiment, I believe? Yes; it is well known.

What was the result of that experiment? What was the comparative effect of those two flames of equal size? It is nearly as three to one, provived the combustion of the gas is properly effected.

That is it gives three times as much light as the flame of a tallow candle will do? Yes.

It is upon that calculation, that the intensity of the light is ascertained? It is.

It is upon that calculation upon which St. James's parish is to have only eight hundred lights? I am not acquainted with that fact.

Have you made the experiment sufficiently accurate to satisfy you of its correctness? I have made it lately, and I have made it before, and I am perfectly satisfied that there cannot be any error.

There are no sparks from these flames? With gaseous bodies there cannot be any sparks. No spark can issue from it.

In what way have you observed the burners to be perforated to let the gas out? They have simple holes.

I believe they may be made, so as to render it very difficult for the wind or rain to extinguish them? It will not be effected much by the wind, so as to produce extinction, and the rain may assuredly be guarded against.

With respect to light-houses; might it be used with advantage for them? I have reason to suppose it might.

Have you made any experiments to show the quantity of light produced by a given quantity of coal? I have.

Be so good as to state them. From late experiments which I have made with the apparatus of Mr. Winsor, to ascertain the quantity of light which a given quantity of coal, either by weight or measure, is capable of affording, I have reason to state, that three bushels of coal affords a quantity of light which is equal to one thousand four hundred and seventy candles at twelve to the pound, these candles burning for four hours.

Then if that quantity of coal was burnt for four hours, it would produce an equal light to that number of candles? It would.

Have you made that experiment yourself? I have. I was informed that in the apparatus of Mr. Winsor, there had been placed three bushels of coal. I was present when the process for producing the gas was carried into execution. I was called upon to witness the state of the different flames, and during the burning, which lasted for twenty-four hours, I witnessed the burning of them for eight hours; that is, from twelve at noon till ten at night. I was also told, that there were persons there, to notice and minute down the different changes which might take place in the different flames; and from their results given to me the next day I calculated the quantity of light.

From this quantity of coal then, there was produced this quantity of light? Yes.

Mr. Accum examined by the committee.

You have said that the difference between a gas flame and that of a candle of equal magnitude is in the proportion of nearly three to one? Nearly three to one, in regard to the quantity of light.

But you do not mean to say, that it will throw a given quantity of light three times the distance? I did not try that experiment.

You made no experiment upon that point? No.

You know that in lighting a street, the thing that is required is a given quantity of light at each particular point? Certainly.

Now, do you mean to state that, if I put a candle here, and another candle there, and a third here at this spot, and then take away these candles and put one of your gas lights there, that there will be as much light there at the third candle as if one candle was there? I do not mean to say that.

Re-examined by Mr. Warren.

Have you ever made a comparison between a light of twelve in the pound tallow candle, and the light of an oil lamp in the street? I have not, so as to speak to it.

By Mr. Brougham.

You have stated, that three bushels of coal gives as much light as one thousand four hundred and seventy tallow candles of twelve to the pound, burning for four hours; do you mean to say, that two pounds of coal give as much light as one pound of tallow? I am entirely unacquainted to speak on that subject.

Do you know how many pounds there are in a bushel of coal? I have weighed them, but have not the minutes with me, and am not prepared to answer it. I have weighed a measured quantity of coal, and know the weight, and can tell you to-morrow.

Mr. Accum called, and examined by Mr. Warren.

Have you dealt at all in turpentine? Yes; and I deal in it now.

And are you a good judge of the price of it? I flatter myself I am.

You have stated already, that oil is procured from the coal; what is oil of turpentine selling for now per gallon? It sells now at ten or eleven guineas per hundred weight.

Have you not reduced that to gallons? It is about 2*s*. a pound, or 10*s*. a gallon.

What is the highest at which you have ever known it? About 45*s*. and that not above six weeks ago. I value it at ten guineas per hundred weight, by which I can sell it now at 10*s*. a gallon.

Do you know what it is sold at now in the market? At the price I stated; that is the price I would sell it at now.

Do you know the usual price of turpentine? It is an exceedingly fluctuating article.

How low have you ever known it? It has never been under 7*s*. a gallon for these fifteen years at least, as long as I have been in this country.

Was 45*s*. the highest you have ever known it? It never was higher than that price.

What is the comparison of the light given by Mr. Winsor's cock's spur lamp, and that given by the common parish lamp? Having found that each of the cock's spur lamps has a flame equal to three inches in length, which makes of course nine inches of flame, and having found also that the parish lamp, which burns with a bright flame, is about half an inch, it follows that nine inches of gas flame are equal to eighteen and a half inches of parish light. These are approximations I merely give in round numbers, that is, eighteen inches in bulk altogether.

What is the comparative effect of the light given? Having also found that the intensity of the gas light, as stated often before, is as three to one, it follows that three cock's-spur burners are equal in intensity to, I believe, fifty-four parish lights; but, however, I will deduct one third-part of the intensity of the light.

That is the mode in which you made your calculations? It is the mode; but I will neglect one third-part, so as to make it only as two to one.

The experiment you made makes it as three to one? As three to one.

Have you calculated what quantity of coal it will be necessary to use to supply eight hundred of Mr. Winsor's cock's-spur lamps, in the same way as they burn every night in Pall Mall, taking the light for eleven hours upon the average? I do not know that I can speak correctly to that, but two chaldrons will amply do it; I have made the calculation repeatedly.

That is, to supply the lamps every night in the year? For eleven hours it is amply sufficient.

Be so good as to state, from your knowledge, what the average price of coke is, comparing the chaldron of coke with the chaldron of coal? It is usually upon a par with coal, but sometimes it is 1*s*. 2*s*. or 3*s*. below i, but it is seldom above it.

You do not prove the price of coal, I believe? That varies very much.

Cross-examined by Mr. Brougham.

You yesterday stated the mode in which you compared the light of a tallow candle with the light of the gas burners? I did.

And upon being asked what the result of the experiment was you stated, that it was nearly three to one in favour of the gas? I did say so.

Did you mean thereby to state, that the gas-light burner gave three times as much light as a tallow candle? I did mean to say so; that a gas flame of the same size furnished as much light as three tallow candles producing the same flame.

Then how much light does the gas give, compared with the common lamp? That may be learnt from the statement, that it requires two parish lamps to give as much light as one of the candles that I burned.

Then two parish lamps give as much light as a penny candle? They do.

Therefore six parish lamps give the same light as three candles? They would do so.

Now three candles give the same light as one gas lamp? They do.

Therefore you mean to say, that six parish lamps give the same light as one gas light? Yes; it follows from it.

Do you mean to say, that six parish lamps give the same light with one gas light of the same size? Certainly, comparing bulk for bulk; I mean to say that there is six times as much bulk of flame in the gas light as there is in the parish lamp.

Suppose the bulk of the gas light were equal to the bulk of the parish lamp, which would give the most light? The gas light, undoubtedly.

Then in making this estimate, every thing depends upon the bulk? Upon the bulk and the intensity of light.

And the intensity of the light alone is not sufficient to make the estimate, but the bulk is also necessary? Both must be taken into consideration.

Then your estimate depends upon the measure of the bulk, and upon the intensity? My estimate does.

Mr. G. B. Bridges called, and examined by Mr. Warren.

Have you attended any of the experiments for carbonizing coal at Mr. Winsor's? I have, seven experiments.

Were the receivers, upon the contents of which those experiments were made, locked and sealed by yourself? Yes, they were.

And the keys kept by you? In my constant possession.

What was the quantity of bushels of coal upon which the experiments were made? The whole seven were made upon twenty-four and a half bushels of coal.

Have you a statement of the quantity of ammoniacal liquor produced in the number of pounds? The number of pints of ammoniacal liquor was one hundred and fourteen, or fourteen gallons, or thereabouts.

What was the quantity of tar produced? One hundred and fourteen pounds and three-quarters.

Was that the same coal from which the ammoniacal liquor had been drawn? They were drawn out of the same receiver, and from the same coal.

Mr. Peter Davy called, and examined by Mr. Warren.

Are you a coal merchant? I am a coal-buyer.

What is the present price of Tanfield Moor and Wallsend coals? The present price of Wallsend coal is 57*s.*; and Tanfield Moor is 48*s.* 6*d.* I must beg leave to observe, that the difference is greater at this time than usual, by far. There is not in general so much difference as there is at this moment, owing to a combination in the north.

Are both of these Newcastle coal? They are.

What is the price of the low, or more ordinary sort? The present price of coal is from 57*s*. down to about 45*s*.

Do you mean of Newcastle coals? Some very inferior Newcastle coals are very nearly as low as 45*s*. There is one sort which is as low.

Large dealers, taking the opportunity of the market, could purchase them at a price lower than that? The best coals may certainly be bought considerably lower, and inferior coals something lower.

Can you state with any degree of accuracy, how much lower the best might be bought? From 6*s*. to 8*s*. lower.

The Wallsend are always higher than the others? There are several kinds come under the denomination of best coals; but Wallsend are generally among the best. There are two others at this moment.

Mr. George Lee called, and examined by Mr. Brougham.

Will you state in what line of business you are engaged? I am a proprietor of cotton mills in Lancashire.

What is the firm of your house? Phillips and Lee.

Have you ever seen any of the apparatus for lighting by means of gas? Yes.

Will you state to the committee how long it is since you first saw it? It was about the year 1804.

What was the apparatus which you then saw? It was a small experiment made in my house, to determine whether it was applicable to the mills.

To your cotton mills? Yes.

Was it to determine whether this apparatus would light the cotton mills by means of gas? Yes.

Where did you see it? In my own house.

Did the experiment succeed? Yes.

What did you do in consequence? I lighted the house first to try if it was wholesome.

Your dwelling house? Yes.

Did you then light your cotton mills? Not then, but immediately afterwards.

When did you first order the apparatus for lighting your cotton mills? In the year 1805, immediately succeding that experiment in 1804.

From whom did you order it? From Messrs. Boulton and Watt.

When was it put up? In 1806 most part of it, and it was completed in 1807.

Have you found it to answer? Perfectly.

Have you ever compared the effect of this mode of lighting with the common mode? Yes.

In what manner did you make your comparison? You mean the effect of the intensity of the light, and that of the economy.

First as to the intensity, and then as to the economy? The mode of determining the intensity of the light was by means of shadows.

Will you describe the complete process? A quantity of gas was burnt which corresponded with the flame from a candle. We projected the same against the wall and observed the opaqueness of the shadow, and from that we assumed this standard.

Then you made the two lights of equal intensity? Exactly, the shadows corresponded with each other in point of opaqueness.

Then in respect of the economy? In order to determine the expense or economy of producing the gas, compared with tallow, the gas was measured in a gasometer, a vessel holding gas, suspended in water. The quantity of gas consumed in a given time, producing the same light with the tallow, was measured with the gasometer and weighed with the candles, by which means we obtained a comparison of the bulk of the gas, and the weight of the tallow.

And what was the result of that comparison? The result of that comparison was, that a half cubic foot of gas corresponded with a candle of six in the pound, burning for an hour. These experiments were made under my direction and inspection.

You then calculated how much tallow was consumed? Yes, I did.

And how much was consumed in an hour? One hundred weight of coal produced three hundred and fifty feet cubic of gas; from that experiment, six pounds of coal will be found as equal to one pound of tallow, which coal yields illuminating matter equal to one pound of tallow. (i.e. one bushel coal = 13lbs. of tallow. T.C.)

Will you state to the committee what saving there has been, by means of this process, in your manufactory? I suppose by saving you mean in expense.

Yes, saving in money. Reckoning a fair allowance for the use of the machines, I believe it appears on the report of Mr. Murdock, the particulars for which I gave to him.

How much have you laid out on this apparatus? Between 5,000*l* and 6,000*l*.

What is the total expense of the gas apparatus by the year? The particulars are stated in that report, but I believe it is about 500*l* a year.

What would be the expense of candles, to give the same light? About double.

Have you got any memorandums, from which you can state the particulars? Here are the memorandums:

Cost of one hundred and ten tons of cannel coal - - - - - -	l125 0 0
Do. of forty tons of common do. - - -	20 0 0
	145 0 0
Deduct value of seventy tons coke - -	93 9 0
The annual expenditure in coal, after deducting the value of the coke, and without allowing any thing for the tar, is therefore - - - - - -	52 0 0
And the interest of capital, and wear and tear of apparatus - - - -	550 0 0

Making the expense of the gas apparatus about l600 per annum.

You sold the coke which you made? Yes.

Did you sell the tar? We did.

In considerable quantities? I suppose fifty or one hundred barrels.

Do you continue the lighting of your manufactory in the same way now? Yes.

You find it still to answer? Perfectly.

Had you any difficulty in getting the apparatus from Messrs. Boulton and Watt? None.

You got it as soon as it was ordered? As soon as could be expected; the most part of it was put up the first winter.

Did Mr. Phipps, from any of the London assurance offices, visit your manufactory? He did.

And saw the process of lighting it? He did.

Have you any part of the street lighted, as well as the manufactory? The street leading down to my house and the lamp at the door are lighted.

By means of tubes? Yes.

I believe there are two sorts of burners used? Yes.

What are the names of them? One is called the cock's-spur, and the other the Argand lamp.

The cock's-spur has how many burners? It has three.

And the Argand lamp, how many has that? It resembles the common Argand lamp.

Have you seen the lamps in Pall-Mall? Yes.

Did you compare their effect with that of your own? I did.

Did you see any superiority from those in Pall-Mall? By no means.

When Mr. Phipps saw your's, was he satisfied as to the safety of it from fire? Perfectly. Most of the offices have seen it. The Sun office offered to insure it for 1*s*. 3*d*. the usual premium; other circumstances were taken into consideration, but they did not make any objection, but rather otherwise, on account of the gas

Mr. Phipps expressed himself perfectly satisfied? Mr. Phipps did equally so; but I adverted then to the Sun office.

Is there any disagreeable smell produced by the gas? Nothing objectionable; not at all.

Is the light clear and agreeable to the eye? Far superior to any other light.

You have had every reason to be satisfied with it, ever since you tried the experiment? Perfectly.

Have you lately been at the manufactory of Messrs. Boulton and Watt, at Soho? Not lately, but I was there last year.

Have you seen any apparatus besides your own? I have.

In whose house was that? In no house; but in a mill where it was preparing, and I have seen many others.

In whose mill was it? In Messrs. Burleys'.

Did it answer there? Perfectly; I did not see it burning, but my own did so well, and I was so well satisfied with it, that I concluded it would.

Was that completed which was in the possession of Messrs. Burley and Co? Not perfectly; but nearly so.

From your knowledge of trade and manufacture in general, do you conceive that the manufacture of apparatus for lighting mills and other manufactories, requires a very great capital? I think not.

Is a great capital, then, commonly met with in trade? Certainly not.

Do you know many persons with larger capitals than would be necessary for such a purpose? Many.

In Lancashire? Yes; and not only there.

In Staffordshire and Warwickshire? Yes; wherever there are large manufacturers.

Cross examined by Mr. Warren.

With respect to the insurance, you said that in this house of your's there were other circumstances which operated, besides its being lighted with gas; it has a copper or iron floor, I believe? No, it has not.

Then what other circumstances are there? I was speaking of the mill, which is not warmed with a common fire, and the floors are sheeted with iron.

They expressed no objection, on the ground of danger arising from the gas? They did not.

You say it has no offensive smell? No offensive smell.

And gives a very pure and good light? I burn it in my own house instead of thirty pair of candles every night.

How much gas is produced from a certain quantity of coal? In round reckoning, a pound of coals will produce three cubic feet, nearly, of gas, so that three hundred and fifty, divided by one hundred and twelve, I fancy, is about the thing. There is very nearly three cubic feet of gas to a pound of coal. A candle, of six in the pound, burning for an hour, takes half a cubic foot of gas; consequently, there is six to one, which is precisely what I stated.

Will the candle only burn for one hour? I only compare the burning of the candle.

Do you mean that a candle of six to the pound is all consumed in the space of one hour? No.

Then will you explain what you mean? It is burnt in the time that the half cubic foot of gas is. The candle corresponds with half a cubic foot of gas.

Then you understand that this candle is consumed entirely in one hour? Yes, it is, and corresponds with half a cubic foot of gas.

Will not a candle of six in the pound burn for more than one hour? I believe there has a little confusion arisen, in respect to the quantity of light and the consumption of tallow. The total quantity of light used during the hours of burning has been ascertained by a comparison of shadows, to be about equal to the light which two thousand five hundred mould candles of six to the pound would give, each of the candles, with which the comparison was made, consuming at the rate of one hundred and seventy-five grains of tallow per hour.

Then I understand you mean, that that proportion of the candle which will be consumed of its tallow is one hundred and seventy-five grains? That is the comparison.

And of course half a cubic foot of gas is equal to the consumption of one hundred and seventy-five grains of tallow? Yes; exactly so.

You said that the light in your manufactory was equal to that of two thousand five hundred candles of six in the pound? Yes.

How many apertures are there in the pipes out of which the gas comes? The number of burners employed in all the buildings amounts to two hundred and seventy-one Argand lamps, and six hundred and thirty-three cock's-spurs.

They are of the nature described here before? Pretty nearly, but not quite so.

What is the width of the aperture, and what is the length of the flame? I cannot tell.

Can you tell the width or the length of the aperture? No; I do not think it necessary to ascertain it. I believe the aperture is the thirtieth part of an inch, but I do not recollect the size of the flame of the cock's-spur and of the Argand lamp; I cannot state it.

What kind of coal did you make use of? The cannel coal.

In what manner did you weigh the gas? I measured the gas. I weighed the tallow and measured the gas.

Of course then you did not know the weight, and cannot speak to the weight of the gas at all? No; only to the bulk.

You know that it enlarges itself, and is more or less compressed at certain times, and therefore the observations must be very different when it is compressed to what they are when it is not compressed? Of course.

What state was it in when you made the comparison? It was in the gasometer.

Was it in the state in which it came from the coals? Not exactly.

Then the experiment you tried was only made to apply to it when it was in the gasometer? Yes.

If the experiment had been made on the gas as it came from the coal, you might have made a very different calculation? Very little, the pressure is so small.

In the calculation of the expense, is the price of the materials used there included? They are.

You know nothing of the expense of laying down pipes for the purpose of lighting the streets? No; I do not.

Then your experience of the gas does not go beyond its use in private mills and houses? No; it does not.

Have you observed whether the gas is different at different periods? It is.

So that the result of your experiment only applied to the gas in that particular state? It was corroborated and confirmed by actual practice on a large scale, and this is the average estimate on the consumption of two chaldrons a night.

Have you made any experiments on Newcastle coal. No; I have not myself.

Have you seen them made at any time, so as to be able to state any deductions you have made from it? There were some experiments made by Dr. Henry, of our town, but I did not see them made. I have seen them tried upon many other kinds of coal.

How many hours do you burn your lights in the longest and shortest days, in summer and winter? Perhaps ten hours on the shortest days, and two hours on the longest days.

Is the health of your manufacturers at all affected by the use of gas? Not in the least, or I would not have adopted it. I believe I explained to the committee, that I used it in my own house first. There is an additional ventilation, so as to enable the men to bear the heat which is produced.

You have not seen the smallest alteration in the health of your workmen? Not in the least, for had I seen it, it would have been a fatal objection to it.

And you say the same in regard to the use of it in your own family? Certainly I do.

Yo made a calculation concerning the consumption of gas. When you make that calculation do you take into the account what money you receive for the coke and tar? The coke I did.

But you did not the money received for the tar and other articles? The tar included all the other articles, as it came from the retort.

But I wish to know if you did, or did not, take into consideration the value of the tar produced? The value of the tar was so trifling, that I did not think it an object worth consideration. I believe in two years it came to 100*l.*

But, whatever it was, it would reduce the expense of the gas to something less? Yes; to rather less, but very little.

You say it was about a 100*l.* in two years? I should consider that we have sold 100*l.* pounds worth in that time.

Then you did not follow up the tar to all the advantage which might be derived from the other articles? No, we sold it to other manufacturers. The whole was united in the tar, and all the residue was received into a condenser, and sold in that state.

But are not the other articles profitable for use? There are some hazards in the distillation.

Have the goodness to state what is the length of the street leading to your house, which is lighted by the gas-light? The whole length of this street is about six hundred feet, and my house is about half the way down, and it is lighted down to my house.

You mean it is a lane leading down to your house, but it is not the main street? It is a private street, but it is as large as the main street.

What may be the length of that part of the street which is lighted? I suppose three hundred feet.

How many burners are there in that length? They are large burners. There are two Argand lamps and a cock's-spur at my door; but they are double lamps, and that is a double cock's-spur.

They are lighted from the furnace in your house? They are supplied from the manufactory by tubes placed under the street.

But there are only three burners in the whole length of this street? There are only three, but they are large ones.

Where does the furnace stand, I mean with respect to the street? At the utmost extremity; and on one side.

What is the utmost extent to which the gas is sent by these means? I suppose, taking the various turnings which it is obliged to do, before it arrives at the end of the street, it is about one thousand feet.

Then you mean that these turnings are used to light the manufactory? Yes; upstairs and downstairs, and sideways, and in all directions.

That is in lighting the dwelling house as well as the street? Yes, it is.

In the beginning of your evidence you said, that the criterion by which you calculated the different intensities of the light, produced from tallow and from gas light, was the opacity of the shadow? Yes.

Do you mean, that it was from the dimensions of the shadow upon the wall? No; it was the darkness of the shadow.

Do you apprehend that to be an accurate way of examining the intensities of light? It is considered as such.

Do you not know, that in the flame produced by a tallow candle there is a wick? Yes, there is.

But in the gas light it is mere pure flame? Exactly so.

Then there cannot be so much flame from a tallow candle as there is from a gas light? I made no comparison between the size of the flames; but the comparison was of the light as shone by the flame, by adjusting the stop-cock, to produce a flame of gas correspondent with the flame of a candle.

Do you mean that the dimensions of the shadows, produced by the two flames, are equal; and do you therefore conceive that the intensity of the light must be equal also: Is it an accurate calculation, because there cannot be so much flame produced by the light of the tallow candle as from the gas, because there is a wick in the tallow, therefore how can it be accurate? The shadow is not produced by the size of the flame, but by the intensity of the light, and the darkness of the shadow is the measure of the intensity.

Is not a part of the shadow from the candle produced by the wick? No; it is not. There is a body placed between the candle and the wall, and between the gas light and the wall, and it is a shadow of that cylinder, or of that flat body, which is exhibited upon the wall.

Is it your opinion that the streets could be lighted in this manner with advantage? I am not a manufacturer of lighting apparatus.

Can the public be served with gas light by a corporate body to more advantage than by individuals? Certainly not.

From your knowledge of the process, would it require more money to carry on an establishment, in order to supply one district of a town, than is within the reach of a private company, or individuals? Certainly it is within the reach of private capitals.

Would not a company, placed out of the reach of the bankrupt laws, be destructive of free competition? It is evident to me that it would.

What length of time were Messrs. Boulton and Watt in producing this machinery for your house; was it two years, or one year, or what time were they in making it? It was begun the latter end of one winter, and was completed the next; so that it was one winter and part of another; but we did not want it in the intermediate time.

What do you allow for wear and tear in your machinery? It varies upon the pipes, the retorts, and other parts of the machinery.

What is the length of the pipes in your manufactory; what is the whole length together in all directions? I dare say it is between two and three miles.

Are they furnished with gas from one or more fires? There are six fires together, which, according to the length of time people work, are more or less employed.

Are they placed in different parts of the manufactory, or do you mean that they are together? They are by the side of each other.

And from those the pipes are supplied? Yes: I do not mean that the pipes are in one length, but altogether they make about that distance. There are side branches from the mains, and they are continuations of the same stream of gas.

But supposing there were no branches from the pipe, and it went up in the shape of a corkscrew from the top to the bottom, what would be the length of it? I mentioned that there were one thousand feet of main in a direct line, exclusive of the collateral branches. There is a perpendicular pipe through which the gas passes, and a longitudinal pipe carried from the main; sometimes there is one and sometimes two, according to the light which is required.

What is the direct length of the perpendicular pipe, and of the longitudinal pipes? The direct length of them connected with each other, and going with one and the same stream of gas, must be one thousand feet.

Is that the same stream of gas as that which goes along the street? No; it is the same as my house is, only a branch.

How long is it since you have been in the habit of lighting the street with gas? I believe since 1807.

You stated that it was a year, that is, from the beginning of one winter to the beginning of another, before Messrs. Boulton and Watt produced the machinery for your house: Would it take that time to produce a machinery of that sort, or did the delay arise from your wish not to have it made sooner? In that state we were making experiments, and were not anxious to have it sooner; but I suppose it might be made in three months now.

What is the diameter of the main? About five inches.

Is it the same size all the way, or does it taper towards the end? It tapers to about half an inch gradually.

I believe you likewise make use of the reservoirs? We do of gasometers.

What is the size of them They are cubes of ten feet, so as to have a content of one thousand feet.

Will you be so good as to explain the construction of the gasometer? The gasometer is a hollow vessel immersed in water, and suspended upon a pulley by a counter weight nearly corresponding.

What is the gasometer made of? It is sheet iron, painted. The gasometer and the weight are not quite in equilibrio, but the difference is equal to a column of water of half an inch, which, of course, makes the pressure of the gas correspond with that column of water.

Then the gas comes from the retort through a pipe into this gasometer? Yes.

And there is another pipe leading from this gasometer to the mains? That is not necessary; the same tube would answer.

Then the gas is communicated from this gasometer to the burners? It is.

Supposing more gas were to come over from the retort into the gasometer than it could hold, what would be the consequence? There are eleven of them. The consequence would be, that when the pressure was more than a column of water of half an inch, it would force itself through the water by bubbling up.

Supposing it were to come over with great rapidity, would it bubble up quicker? Yes.

Could any other effect take place in consequence of that? It is impossible. But independent of that, there is a column of water of half an inch applied to a receptacle before it comes there.

So that the utmost extent of the effects would be, that a little of the gas would escape? The water would be blown away, and the gas would flow out from the first tract.

Could any danger result from this? Impossible.

What sort of iron is the whole of the gas machinery? All the mains are cast iron, but the smaller pipes are sheet iron.

For what purpose is the gas received into this gasometer, between the retort and the burners? To take away any superfluous quantity of gas which would be formed, that is not consumed, and to enable the manufacture of the gas to go on at the time it is not burning.

Then the retorts are never cold? Never.

And a considerable saving takes place in consequence? Of course.

Is it your opinion that Messrs. Boulton and Watt would be able to execute an order to the same extent as your's in less time than they executed your's in? I should think, by the preparation which they have made, they would deliver the materials to be put up in far less time.

Supposing a fair competition was to prevail, would not the public be served with more expedition by individuals than under a monopoly? In my opinion they would.

Are you of opinion that a fair competition could exist, if a corporation were to be established in that pursuit? Certainly not.

What was the weight of the iron employed in the whole of the gas apparatus in your establishment? I do not know.

On what ground do you form your opinion, that a fair competition could not exist if a corporation were to be established? If a corporate body was suddenly to be performed in my own business, and so much additional capital suddenly brought in under circumstances unfavourable to me, my trade would be injured by it.

Would not the same effect be produced by the union of two or three wealthy individuals, such as sir Robert Peele and yourself, which is neither impossible nor unusual?—

By sir Robert Peele.

Whether, if myself and three or four more opulent individuals were to unite forming a private company, would not the whole of our respective fortunes be committed by it, and answerable to the creditors? Certainly.

Would the subscribers to a corporation be answerable for more than the sum of money annexed to their respective names? For no more.

If I understood you rightly, you said just now, that the having a large society, or large capital brought into a trade, would prevent competition, and, in your own case, if several wealthy persons were to come into the market it would put you in a disadvantageous situation? Yes; under the circumstances of a corporate body.

Would not the public be better supplied by a corporate body? I think that the public is always injured, when competition is diminished.

Mr. Lee called, to correct a part of the evidence given by him yesterday. Examined by Mr. Brougham.

A question and answer put to and given by the witness was read to him; to which he gave the following additional answer:—We had always used oil before; the difference of expense between oil and coal would be fifty per cent. and the difference between candles and coal seventy per cent.

Another question and answer were read to the witness, to which Mr. Lee said,—I meant to say tons of coal. We buy by tons in the north, that is 20cwt. to a ton, instead of 28cwt. to a chaldron, which is the custom in London.

Do you mean to say that about 6lbs. of coal by the gas process give as much light as 1lb. of tallow? I do, and I will explain the experiment by which it is proved. I will explain first the apparatus, which is the photometer; the measure of the light itself; the darkness of the shadow cast upon the wall by a cylinder interposed between the candle and the wall, measures the intensity of the light; consequently, if a candle and a gas burner, adjusted by a stop-cock, produced the same darkness of shadow at the same distance from the wall, the intensity of light is the same, and uniform degree of light from the gas is produced by opening or shutting the cock if more or less is required, and the candle is carefully snuffed, so as to produce the greatest and most regular quantity of light from it. The size of the flame of course becomes unnecessary in this consideration, and will vary with the quality of the gas; the gasometer, as the quality of the gas is subject to some variations, the experimental gasometer* was supplied from the mixed production of several retorts, and the result is the average of a vast number of experiments taken during the whole winter. The gasometer which was used for the experiment contains a measured quantity of gas, and the communication between it and the retort, and any other supply, was intercepted, during the experiment, by a cock. The gasometer descends in the water as the gas is exhausted, and the bulk of the gas used is ascertained by the area of the gasometer, and the depth which it sinks in the water; therefore the bulk of the gas consumed in a given time is measured by the gasometer, and the quantity of tallow used is determined by weighing the candle before and after the experiment. Results.—The light produced by a candle of six in the pound, requires 175 grains of tallow in an hour; 7000 grains are equal to a pound avoirdupoise, and consequently 1lb. of candles of six in the pound, burning one at a time in succession, would last $\frac{7000}{175}$ = 40 hours. One half of a cubic foot of gas expended per hour produces the same quantity of light; consequently, one-half multiplied by forty hours equals twenty feet of gas expended in forty hours; consequently equal to 1lb. of candles.

It is equal to the candles without reference to the time? Yes.

First the measure of the quantity of tallow is ascertained, then the quantity of gas to produce the same

* Thus in the original report.—T. C.

effect, and then the gas and tallow are compared together without reference to the time? Exactly so. Twenty cubic feet of gas are equal to 1lb. of tallow. One hundred and twelve pounds of coal produced nearly three hundred and fifty cubic feet of gas; and three hundred and fifty cubic feet of gas, are equal to three hundred and fifty, divided by twenty, which last is equivalent to one pound of tallow, and makes one hundred and twelve pounds of coal, equal to $\frac{350}{20} = 17\frac{1}{2}$ pounds of tallow; consequently one hundred and twelve pounds of coal, divided by seventeen and a half of tallow, is six and four-tenths of coal, for one pound of tallow. That is the experiment.

What species of coal was it you made use of? The cannel coal, that giving the most light.

What is the price of it on the spot? It is fifty per cent. higher than the other, and is 13½*d.* per hundred weight. The whole quantity of gas consumed in the manufactory, and the whole quantity of coal consumed in the retorts, was registered from day to day for a considerable time, and nearly corresponded with this experiment.

Have you seen the lights in Pall-Mall? I have.

As you have been accustomed to make comparisons of this sort; do you think the light in Pall Mall, or that in your manufactory is the stronger? Ours is the clearest and the steadiest; but this is rather partial evidence.

Cross examined by Mr. Warren.

The comparison you speak of was made from recollection. You had no light with you to judge by? No; but the habit of looking at those things familiarizes one to them.

But it was made from recollection? Of course I could not compare them otherwise.

If one of your gasometers were to blow up, would it blow up the other ten? No.

But all would go off in succession? All would go off in succession.

Re-examined by Mr. Brougham.

Do you apprehend that your gasometer could go off? I do not think it is possible.

Have you yet had any accident of that sort? No.

Examined by the Committee.

I believe powder mills sometimes do not go off for ten years together? There are physical causes which would prevent such an accident in this case.

Could a spark getting into the gasometer blow it up? It is impossible.

But if it could get in, is it pure inflammable air, or is there any other air on the inside? It could not take fire without coming in contact with the atmospheric air.

What are the means taken to exclude the atmospheric air? A column of water of half an inch, which it is impossible for the air to pass under.

Do you think it is in perfect security? In perfect security.

Did I understand you rightly to say that Messrs. Boulton and Watt constructed your apparatus? Yes, they did.

You spoke of several others in Manchester? Yes.

Were they all constructed by Messrs. Boulton and Watt? Yes.—I beg your pardon, I believe there has some person attempted it on a small scale, but I cannot speak to that, I never saw any of them. I have only heard of it, and believe it is a trivial thing.

Did you speak of any at any other towns besides Manchester? Yes, at Leeds.

Is that constructed by Messrs. Boulton and Watt? Yes, a gentleman has ordered it in consequence of seeing ours.

But as far as you know they are all constructed by Messrs. Boulton and Watt? Yes, except the small ones which I have not seen.

At what have you reckoned the tallow in your comparison? At 1*s.* per lb. It is stated in Mr. Murdoch's paper.

CHAPTER V.

Further remarks on the safety of Gas Lights.

"There is one subject more on which it is necessary to speak. In the present instance, the public has been alarmed by representations that the general adoption of gas lights would expose us to innumerable accidents, from the inflammable nature of the gas, and the explosion of the apparatus in which it is prepared, or the bursting of the pipes by which it is conveyed. But there is no ground for such fears.

"Those who are familiar with the subject will readily allow, that there is no more risk in the action of a gas light machinery, properly constructed, than there is in the action of a steam-engine, built on just principles.

"The manufacture of the coal gas requires nothing more than what the most ignorant person, with a common degree of care and attention, is competent to perform. The heating of the gas-furnace, the charging of the retorts with coal, the closing them up air-tight, the keeping them red-hot, and discharging them again, are the only operations required in this art; and these, surely, demand no more skill than a few practical lessons can teach to the meanest capacity. The workman is not called upon to exercise his own judgment, because, when the fire is properly managed, the evolution of the gas goes on spontaneously, and without further care, till all the gas is extricated from the coal.

"No part of the machinery is liable to be out of order,—there are no cocks to be turned, no valves to be regulated; nor can the operator derange the apparatus but by the most violent efforts. And when the stock of gas is prepared, we may depend on its lighting power as much as we depend on the light to be obtained from a certain number of candles or oil-lamps.

"The diversified experiments which have been made by different individuals, unconnected with each other, have sufficiently established the perfect safety of the new lights; and numerous manufactories might be named in which the gas lights have now been in use for upwards of seven years, where nothing like an accident has occurred, though the apparatus in all of them is entrusted to the most ignorant man.

"It would be easy to state the causes which have given rise to some of those accidents that have spread alarm amongst the public; but of this it is not my business to speak at length.* It is sufficient, on the pre-

* Why not?—T. C.

sent occasion, to state, that those melancholy occurrences which have happened at some gas light establishments which I have had an opportunity of examining, were totally occasioned by egregious failures committed in the construction of the machinery. Thus, an explosion very lately took place in a manufactory lighted with coal-gas, in consequence of a large quantity of gas escaping into a building, where it mingled with common air, and was set on fire by the approach of a lighted candle. That such an accident could happen, is an evident proof that the machinery was erected by a bungler, unacquainted with the most essential principles of this art; because such an accident might have been effectually prevented, by adapting a waste pipe to the gasometer and gasometer house. By this means, if more gas had been prepared than the gasometer would contain, the superfluous quantity could never have accumulated, but would have been transported out of the building into the open air, in as an effectual manner as the waste-pipe of a water cistern conveys away the superfluous quantity of water, when the cistern is full. Such an expedient did not form part of the machinery.*

"Other instances might be named, where explosions have been occasioned through egregious mistakes having been committed in the erection of the gas light machinery, were this a subject on which I meant to treat.

"That the coal-gas, when mixed with a certain portion of common air, in close vessels, may be in-

* Nor ought it to form part of any machinery: the waste gas ought to be burnt away, and not permitted to escape into the neighbourhood, to become a nuisance by the stench.—T. C.

flamed by the contact of a lighted body, is a fact sufficiently known. But the means of preventing such an occurrence in the common application of gas lights, are so simple, easy, and effectual, that it would be ridiculous to dread danger where there is nothing to be apprehended. In speaking thus of the safety of the gas light illumination, I do not mean to deny that no possible circumstances may occur where the coal-gas may be the cause of accident. It is certain that the gas, when suffered to accumulate in large quantities in close and confined places, where there is no current of air, such as in cellars, vaults, &c. and where it can mix with common air, and remain undisturbed, that it may be liable to take fire when approached by a lighted body; but I do not see how it is probable that such an accumulation of gas should take place in the apartments of dwelling houses. The constant current of air which passes continually through the rooms, is sufficient to prevent the possibility of such an accumulation ever to take place. And with regard to the bursting of the pipes which convey the gas, no accident can possibly happen from that quarter; because the gas which passes through the whole range of pipes sustains a pressure equal to the perpendicular weight of about one inch of water only, and such a weight of course is insufficient to burst iron pipes. Nor could the town, when illuminated by gas lights, be thrown suddenly into darkness, as has been asserted might happen by the fracture of a main pipe, supposing such an event should take place; because the lateral branches, which supply the street-lamps and houses, are supplied by more than one main; and the consequence of a fracture would be only an extinction of the few lamps in the immediate vicinity of the broken pipe, because the rest of the pipes, situated beyond the fracture, would continue to be supplied with gas from the other mains."

CHAPTER VI.

On Coal Gas Establishments becoming a nuisance to the public.

LONDON ADJOURNED SESSIONS,
November 18, 1815.

Gas indicted as a nuisance.

YESTERDAY there was a special adjournment of the London sessions, held before the recorder, aldermen, &c. at Guildhall, for the purpose of trying a question of considerable importance to the scientific world, as well as the public at large. It was an indictment preferred against *Frederick Sparrow* and *William Knight*, laid in the month of May last, and charging them with a public nuisance, but postponed to the present period. On this occasion, however, Mr. Sparrow only appeared in court as the defendant, when the following most respectable jury were sworn:—

EDMOND GOLDSMITH,	THOMAS RICHARDS,
WILLIAM DOWNING,	JOHN BROGDEN,
JOHN SCHOFIELD,	HENRY CARR,
JOHN BEN. COLE,	JOHN MOORE,
JOSEPH D. LEWIN,	WILLIAM LEITH,
ROBERT TRENCH,	SAMUEL THOROUGHGOOD.

Mr. Arabin stated the indictment, which charged the defendant with a public nuisance, by means of a certain manufactory of gas, in Dorset-street, Salisbury-square.

Mr. Gurney stated the case to the jury. He observed, that the question was one of the most vital importance, not alone to the individuals who were experimentally engaged therein, and to the public generally; but more particularly to that class of society, whose fate it was to reside in the precincts of the manufactory, which was now so justly preferred to the consideration of the court, as a common nuisance and public offence. The utility of the gas lights none would have the hardihood to deny—its beauty and brilliancy was equally apparent. The lucrative advantages derived from its establishment were, no doubt, of a very considerable nature with the defendants; yet, under all these circumstances, it was highly necessary that the comfort, the health, and the lives of their fellow-creatures were not to be endangered. The present case, he considered, one of a most flagrant and outrageous nature, because when mischief had been done, and remonstrance made of the evil, the complaint instead of being removed, was even not abated. The gas manufactory of the defendants was first established in Fetter-lane. There it was conducted, as now, by a joint stock company; but the inhabitants of that district finding it necessary to have the establishment indicted as a nuisance, the proprietors removed their manufactory to Dorset-street, where it was commenced upon a more extensive scale. Here the process became equally offensive, and in proportion as the system enlarged, so the effects became more obnoxious and dangerous. It appeared that in the present manufactory there were *four* retorts of considerable size.

Beneath these there were fires constantly burning, the vapour from which was conducted by several iron tubes into a globular vessel, called a *Gasometer*. The smell which issued from this part of the manufactory, was of a most offensive nature. There was also a process of *coke*, which likewise produced an insufferable stench by means of tubes, which carried off the effluvia, and was conducted to the river Thames. This was not alone offensive to the inhabitants and passengers, but even to the bargemen upon the river, in that quarter. Complaints of the evil were made on all sides, and while, in some instances, the most shameful inattention was manifested, in others, the injured applicants were received in a cavalier sort of way, and although promises had been made of remedying the nuisance so bitterly felt, still nothing had been effectually done to remove it, and it remained in all its pernicious force.

An indictment, however, being preferred in May last, by the inhabitants of the district, the defendants, it was understood, had at a considerable expense, adopted experiments by way of improvement. These, however, had not the desired effect, and the nuisance still existed in a minor degree, but still with such contagious effects, that the comfort, the health, and the lives of the inhabitants, were exposed continually to danger. Under these circumstances, he was convinced the court would feel it their duty to pronounce a verdict of condemnation upon the party, and if the latter could not succeed, in so far improving their manufactory, as to obviate the evil in question, they must then abandon their scheme altogether, however lucrative to themselves, or however beneficial to an admiring public, with whom the lives, the safety and convenience of a respectable part of the community, was not to be compared. The learned gentleman concluded by an appeal to the jury, in justice of his case, which he should fully establish by the most respectable and disinterested testimony.

John Hill, examined by Mr. Arabin, deposed, that he was an upholsterer, residing in Crown court, Salisbury-square, about two hundred yards from the building belonging to the Gas-light Company: between the months of February and May last, when the defendants were indicted, he observed something daily issuing from the establishment exceedingly offensive: it was a kind of smoke producing a saline effluvia, which operated upon his senses, and considerably affected his respiration: the smell was of a sour and acrid nature, partly sulphureous, and was altogether most offensive: witness was unwell in the months of December and January last, and was advised by his physician to open his windows occasionally; when he did so, however, he found himself worse from the effects of vapour from the gas; when obliged to go into the street, he was also violently affected; and his health became so bad, that he was eventually obliged to go into the country: this was solely in consequence of the nuisance in question: the smell and smoke which issued from the building, night and day, and the oppressive heat accompanying it, was insupportable. Was convinced that this arose from large fires, which discovered themselves by immense columns of flame. When in bed at night has often wished to get up and quit the house; even on Sundays was as much, if not more affected, than any other day. Witness frequently remonstrated with Mr. Sparrow, and stated the nature of his health. The defendant told him two or three times, something would be done; at another period he was told cavalierly, that if he did not like the situation, he had better leave it. Believes nothing was done prior to the indictment being preferred towards removing the nuisance, or until the burning down of the premises in March last.

Cross examined by Mr. Pooley.

Remembers the burning down of the building, and knows that it was since erected upon a larger scale to obviate the nuisance. A column or funnel of extensive height had been raised to carry the smoke higher up. Admits having complained of a lead manufactory at the rear of his house, about a year since, but did not complain of a distillery in Blackfriars. Thinks he remonstrated with the defendant Sparrow, so late as July or August last.

Examined by Mr. Gurney.

The column is raised much higher, but in thick or windy weather the smoke still comes down, and there are a number of tubes which carry off the vapour from the gasometer, and prove excessively offensive. The tubes are about 53 feet from the ground, and in damp weather the noxious effects are strongly inhaled. Has felt an inconvenience from lead, but it would be ridiculous to compare this with the offensiveness of the gas.

William Barnes examined by Mr. Gurney.

Resides in Water-street: a wall divides his house from the yard of the gas light concern, forming the east side of the manufactory, at the rear of his house. From the month of February to May he experienced the utmost inconvenience and want of comfort from the process of the gas manufactory. There was a constant effusion of apparently deleterious principles, but could not say what these were, not having access to the interior. When the effluvia was abroad, he could not open his windows: this, however, was not hourly, though he daily, when in the house, was affected, but in a lesser degree, and the smell proved exceedingly injurious to his appetite, and that of his wife, who had been affected with a dreadful cough in consequence. His own lungs were hurt, and there was a certain nausea produced upon the stomach. A taste was also continually in his mouth, like sulphureous acid. There was an immense quantity of smoke proceeding from excessive large fires, and when these appeared to be at work, he was compelled to close up his doors and windows. Crown court is situate at the north side of the manufactory, and appeared most affected. The south side being open to the river, the wind usually drove the smoke in that direction. The court was frequently filled with smoke to that degree, that inhabitants or passengers could not walk through it. Could compare the nuisance to nothing but the *bilge water* of a ship, but the stench from the gas was infinitely more excessive. Thinks the evil had increased since the erection of the new building; was compelled to move his larder from the yard, to the upper part of his house, on the eastern side, as he discovered that by leaving it exposed to the vapour from the gas, the victuals became putrid; had given notice to leave his house, but to the present moment could not procure a situation to suit him—would not remain an hour in that quarter if he could remove with any possible convenience—never knew of the least step being taken to abate the nuisance, until the indictment was preferred against the defendants.

William Snoxell resides in Dorset-street, his house is only divided by a wall from the gas manufactory. From February to May last, the most offensive smell was experienced by himself and family, and so great was the stench, that he has frequently been obliged to quit his dinner in one room, and have the table laid in another. It was equally offensive by night as by day, and was as well subsequent as before the new building was raised. Thinks however it was a little diminished of late. In thick weather it was intolerable, and instanced the late lord mayor's day, as being exceedingly offensive and distressing to the inhabitants and passengers. Mr. Hill, the first witness, is his lodger, and gave him notice that he would leave the house in consequence of the nuisance. He had promised, however, to remain, hearing that there was to be an abatement of the evil. The drains which carried off the water from the manufactory, were peculiarly stagnant, and he was obliged to contrive various traps, by which it might escape his premises.

Thomas Edgely is a coal-merchant, and has a wharf adjoining the gas light manufactory, and from which there is a constant stench. This arises principally from the liquor which is let off in the drains, and runs beneath his counting-house into the Thames. The effluvia about the concern causes a smell, and gives a sort of taste like copper to the mouth, seizes upon the palate, and destroys the appetite for a time. Never remembers to smell any thing so offensive in his life; even the *coal-heavers* complain and are sickened by it. Believes it is no easy matter to "*turn a coal-heaver's stomach.*" Had often complained as if affected by verdigrise in his mouth, and an indescribable nausea upon the stomach. Several persons had threatened to desert his wharf in consequence of the nuisance, and persons on business were afraid to come there. At time of high water it was scarcely so bad, but at low water the offensive smell was beyond description. He had remonstrated upon the business with the defendants, and was very politely told every thing should be done to abate the nuisance. Since the indictment was preferred, something had been done, but the evil appeared to him as great as ever. There was a quantity of tar produced from the coke, and this being exposed to the sun, tended much to increase the nuisance. That had however, he understood, been removed. There was, he thought, rather a lessening of the evil, with respect to the vapour and smoke, since the erection of the present building, but with regard to the liquor and drains not the least. Will not say positively that he remonstrated with the defendants Knight and Sparrow before the new building was raised, but thinks he did; is positive he did since.

William Stewart is a shoemaker, also living in Crown court; has been considerably annoyed since February last from the effects of the gas manufactory.—There was a constant noxious smell, and appeared of a sulphureous nature, which made himself and his family very unwell. His complaint was a sickness in the stomach, accompanied with a cough, which occasionally seized him, and lasted about half an hour. His wife was affected in a similar way, and both were more attacked in that way now, than before the new building was erected. The effects of the smoke and vapour, particularly when the wind was at W. or S.W. were dreadful; and the stench from the sewers or drains was often worse than that of putrid carcasses. Is obliged to keep all his windows closed, and passengers complain bitterly as they pass through the court.

Mr. Gurney was proceeding to call other witnesses, when Mr. Pooley, on the part of the defendants, rose, and observed, that after hearing such a body of evidence from the most respectable individuals, and which he was not at all prepared to controvert, it would be at once disrespectful, and a waste of time to the court, to enter into a defence, and submitted that a verdict must be recorded against his clients. He would, however, beg leave to observe that the defendant, Mr. Sparrow, had little or nothing to do with the concern in question, until the middle of March last, and that the evil complained of was rather before than after that period. This gentleman had since then manifested the most anxious desire to remove every ground of complaint, and had gone to a most enormous expense, in adapting plans for that purpose. Some of these had succeeded, but for those other improvements that were meditated, he contended there had not been time. In submitting also on the present occasion to a verdict of conviction, he promised that the evil complained of should be most effectually removed within a given time, and trusted that the court would forego judgment upon the party, until, at least, the sessions in January next. Mr. Knight as well as Mr. Sparrow should plead to the conviction, and both gentlemen would adopt every means which art and money could effect in obviating the nuisance. This was an object as dear to themselves as their existence, in as much as the establishment promised to be one of a most lucrative nature. To obviate any serious ground of opposition to their pursuit, must be, therefore, an object of vital interest.

Mr. *Gurney* on the part of the inhabitants who had preferred the indictment, consented that the judgment of the defendant might be respited until January next, when, if the nuisance was not removed, he would certainly pray the sentence of the court upon them. He had no hope, however, that they would be enabled to effect the promised improvement, the apertures from whence issued the foul air, the extensive fires and the consequent bodies of smoke, were so contingent with the very nature of the establishment itself.

The recorder shortly addressed the jury, and observed, that it only remained for them to pronounce their verdict, the justice of which they would be satisfied with, when he read to them the opinion of lord Mansfield upon the question of a nuisance.—This was delivered in the case of two men who had commenced a chymical process in Whitechapel, the effects of which had caused noxious vapours and smells. On that occasion his lordship held, that it was not actually necessary that the nuisance be unwholesome or tending to indisposition; it was quite sufficient to prove, that it rendered the life of any individual or family uncomfortable.

The defendants were then found *guilty:* their recognizances ordered to be respited; and themselves ordered to appear at the sessions in January next.

On the above article I would remark, that so far as the nuisance depends on the nauseous smell occasioned by the waste gas being let off into the open air, it may be avoided by burning it away. Indeed it may be economically used as fuel, by conveying it under the retorts. If it be a nuisance, thus set at liberty without being burnt, as no doubt it is, the managers well deserve punishment for suffering an escape of stinking vapour that they might economically burn. The nauseous smell occasioned by letting off the refuse liquid products, at the place where they immediately enter the river, may be *greatly* lessened by extending the tunnel into the water, so that the air of the neighbourhood shall not come in contact with the liquids discharged. But some degree of inconvenience must be borne: the great question is, does the convenience overbalance it?

The experiment of procuring gas from pine knots in Canada, and the success of it, would naturally suggest the use of rosin, or, as a cheaper article, pitch.* Mr. Peale, at his museum, in Philadelphia, uses pitch, and I believe (at the suggestion of Dr. Kugler) was the first person who employed that substance. All the inconvenience arising from the smell of *coal*-gas, when it escapes—from the drawing of the charge out of the retorts—from the nauseous odour emitted when the lime-water is discharged wherein the gas is washed—is thus avoided. In England, where the coke of the coal pays all the expense, and where pitch and rosin are imported articles, coal will continue to be used, but I have no

* Pitch is obtained from pine knots. I have long used pine saw-dust.

doubt of the expedience of using pitch, rosin, or even oil of turpentine in this country, where the coke as yet is not in demand, and where the articles now recommended, being of home production, can be chiefly afforded. Mr. Peale, who has succeeded, and well deserves to succeed, in employing this convenient substitute, has no scruple about showing and explaining his apparatus to any man of science who inquires for the purpose of extending useful knowledge. In his apparatus, the oil condensed in the receiver, immersed in water for the purpose, is afterwards employed to dissolve the pitch, which, thus dissolved, descends in a liquid form through an aperture, regulated by a stopcock, down to the bottom or hottest part of the red-hot retort, and is there decomposed, and ascends into the gas holder, after escaping from the condensing receiver. In this way the gas requires no washing in lime water, no noxious vapour is produced, no unpleasant odour arises, and the objections made in the above-mentioned trial are obviated. That this is the best plan for a small manufactory or house there can be no doubt, but I think it would not answer, in point of economy, for the extensive manufactories employed to light a city: the greater cheapness of coal-gas, the greater value of the residual products of coal, and the certainty of procuring it at all times at a regular and reasonable price, rather diminishing than increasing, will secure it a permanent preference: the public must and will weigh the conveniences of the light thus produced, with the inconveniences of the means employed in producing it.

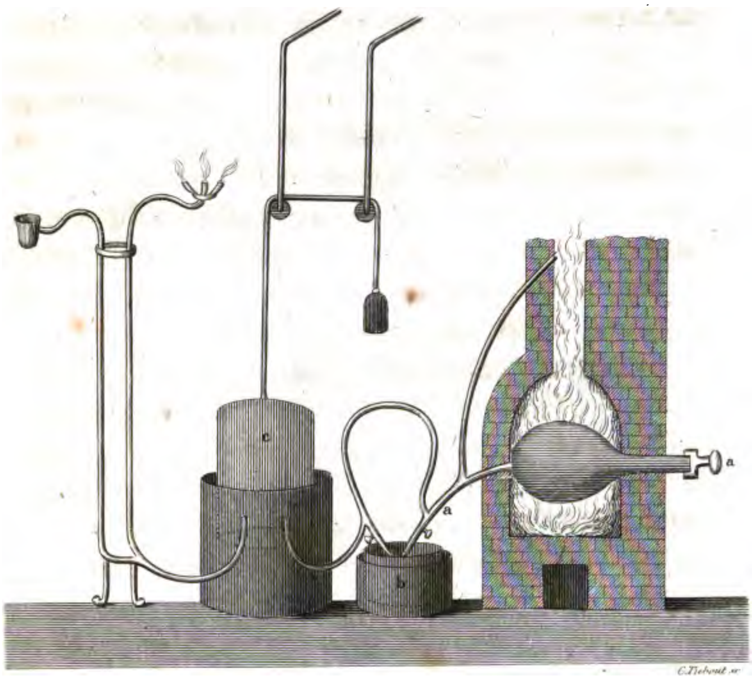
CHAPTER VII.

Of the methods generally employed to obtain the Coal-gas, and the other products of the Distillation of Coal.

Referring the reader to the account of Mr. Peale's method already given in chapter vi, I shall now detail the methods of obtaining this gas on a scale calculated for manufactories, villages, &c. by Mr. Cooke, Mr. Parkes, and Mr. Clegg, the latter gentleman being now principally employed by the gas companies of London. The methods recommended by Mr. Accum are so complicated, and so difficult to be understood, that I shall omit them. They appear to me devoid of that simplicity of contrivance, which is the great excellence of every plan which must ultimately be entrusted to workmen who have no science.

Nor shall I detail the methods of proceeding in the large way, necessary to supply cities, such as Philadelphia or New York, or large sections of such cities. First, because I am fully persuaded that the corresponding extension of the smaller plan will answer every purpose of the larger: and, secondly, because I apprehend it would be manifestly rash and imprudent to venture upon setting up such a plan in Philadelphia or New York, without obtaining, in the *first instance*, every part of the apparatus from England, where experience has taught the managers all the precautions necessary to success, and where every part of the machinery is made so cheaply, that it can be afforded here by importation at a less rate than it can be manufactured here on the spot. By and by, when we also are enabled to profit by the experience which has been dearly pur-

Coal Gas Apparatus.



C. Tiebout sc

chased in England, it will be right and proper to extend the plan by means of our own manufactories; but I cannot recommend to a coal gas association the commencement of it, independently of any resort to those who supply the British establishments. Fulton, whose mechanical skill was of no ordinary stamp, found it prudent to purchase his first steam engines from Boulton and Watt. When he had furnished the models for the American artists to work on, and enabled them to profit by British experience, he resorted to his own countrymen to supply his demand. All the apparatus necessary for lighting the streets of our capital cities can be procured at a reasonable rate, either from the engineers in London, or from Boulton and Watt, of Birmingham.

To persons, therefore, engaged in a coal gas manufactory, on a large scale, no information that *could* be given, either in this, or any other publication, would supersede the prudent necessity of sending to England for the plan, and for the apparatus required to put that plan in active operation in the first attempt; nor if the case were otherwise, would I venture to recommend the complicated machinery, proposed in the handsome copperplate pictures that adorn Mr. Accum's Treatise on Gas Lights. In a manufacturing point of view, and as a general rule, one machine, whether it be an organized human being, or an organized system of iron tubes, is best employed for one purpose instead of many.

After having given the methods recommended by Messrs. Cooke, Parkes, Clegg, and others, I shall offer my own, with the reasons upon which the variations are founded; taking for granted, that although pitch, rosin, or pine knots, may answer on a small scale, the permanent material must be bituminous coal for a city.

—

Apparatus for Coal Gas. Parke's Chymistry. *Plate* 1.

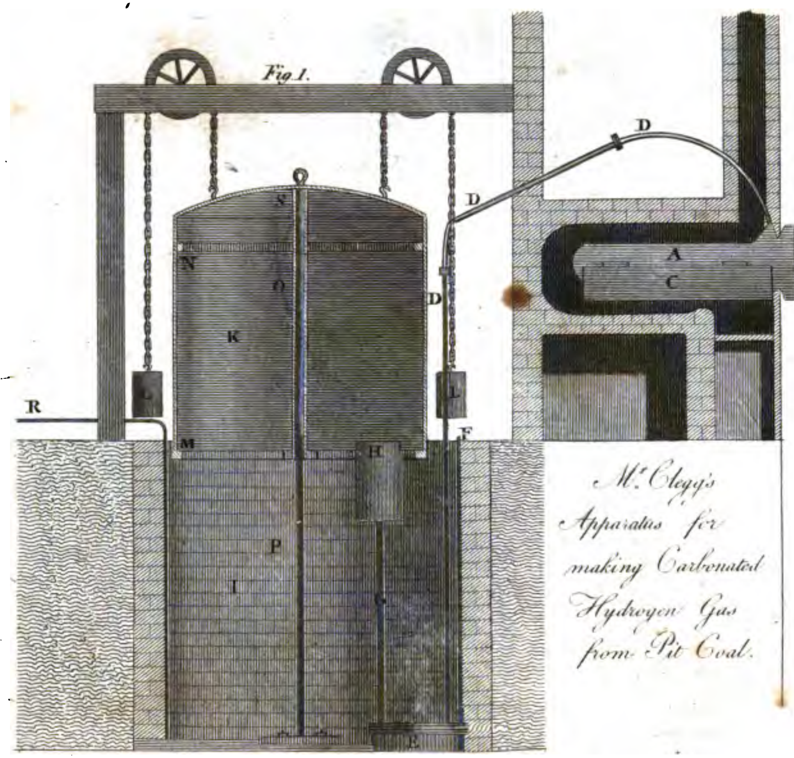
The retort is filled and the coke taken out at D, which should be four inches diameter stopt with an iron plug. The tar and liquid partly runs down the tube with a stop-cock, next the furnace, but some of it mounts with the gas, and being cooled in the bent part of the tube, runs down at the second tube with the stop-cock into the barrel B, which is inserted in an outermost barrel, and surrounded with water to condense the contents. The gas-holder C is suspended with its balance weight from the ceiling. The rest is obvious. The gas holder and its containing vessel may be tin, copper, sheet iron, or simply casks. The perpendicular tube that rises into the chimney is designed to carry off the carbonic gas and water which rise at the beginning of the process, and which, if mixed with the carburetted hydrogen, would hurt the combustible quality of the gas sought for. Quere, if a stop-cock at D would not be useful for the first five or ten minutes? The tubes may be lead, tin, or copper.

The distilled products will pay a great part of the expense.

—

Reference to Mr. S. Clegg's Apparatus for extracting Carburetted Hydrogen Gas from Pit Coal. See Plate 2, figs. 1, 2, 3, 4, 5 *and* 6.

In fig. 1, A shows the cast iron retort, into which are put the coals intended to be decomposed by means of a fire underneath it, the heat of which surrounds



Mr. Clegg's Apparatus for making Carbonated Hydrogen Gas from Pit Coal.

Horizontal Section of the Gazometer at the bottom part

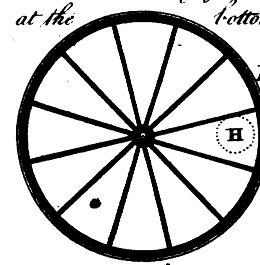


Fig. 2.

Fig. 5.

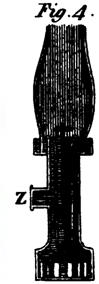


Fig. 4.

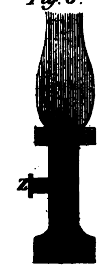


Fig. 3.

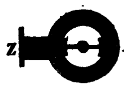


Fig. 6.

C. Tiebout

every part of it, excepting the mouth or part by which the coals are introduced. The lid or iron plate B, which covers the mouth of the retort, is ground on, air-tight, and fastened by means of a screw in the centre; C is a shield or saddle of cast iron, to preserve the retort from being injured by the intensity of the fire underneath it, and to cause it to be heated more uniformly. D D D represents the cast iron pipe which conveys all the volatile products of the coal to the refrigeratory of cast iron E, in which the tar, &c. extracted from the coal, is deposited, and whence they can be pumped out by means of the copper pipe F. G is the pipe which conveys the gas to the top of the cylindrical vessel or receiver H; this receiver is air-tight at the top, and consequently the gas displaces the water, in the vessel H, to a level with the small holes, where the gas is suffered to escape and rise through the water of the well I, into the large gasometer K. The use of the vessel H is pointed out as follows, viz. If the pipe G reached all through the water, without passing into the vessel H, the gas would not be rendered pure or washed: and if part of the pipe did not rise above the water, the water would have free communication with the tar, besides exposing the retort A to a very great pressure, so as to endanger its bursting when red-hot. This vessel or receiver H, in a large apparatus, is about eighteen inches diameter, and two feet long: the quantity of gas therefore which it contains, is sufficient to fill the pipes and retort when cool, prevent the pipe G from acting as a siphon, and expose the gas to the water without endangering the retort.

When the operation begins, the upper part of the cylindrical gasometer K, fig. 1, made of wrought iron plates, is sunk down nearly to a level with the top of the circular well I, and is consequently nearly filled with water, but it rises gradually, as the gas enters it, and displaces the water; the two weights L L, suspended over pullies by chains, keep it steady, and prevent its turning round; otherwise the lower stays M of the gasometer would come into contact with the vessel H. There are two sets of these stays, one shown at M, and the other at N.

There is also an iron pipe O, made fast in the centre of the gasometer by means of the stays, which slides over the upright pipe P, by which contrivance the gasometer is kept firm and steady, when out of the well; it likewise prevents the gas from getting into the cast iron pipe P, and the copper pipe R, any where but through small holes made in the pipe O at S, at the top of the gasometer, where the gas is perfectly transparent and fit for use.

The pure gas enters the tube O at the small holes made in its top at S, and passes on through the tubes P and R to the lamps, where it is consumed and burnt.

The seams of the gasometer are luted, to make them air-tight, and the whole well painted inside and out, to preserve it from rust.

Fig. 2 shows a horizontal section of the lower hoop of the gasometer K at the part M, with its stays or arms, and the manner in which the iron pipe O, before described in fig. 1, sliding on the tube P, passes through the ring in the centre of the hoop. A horizontal section of the receiver H appears therein.

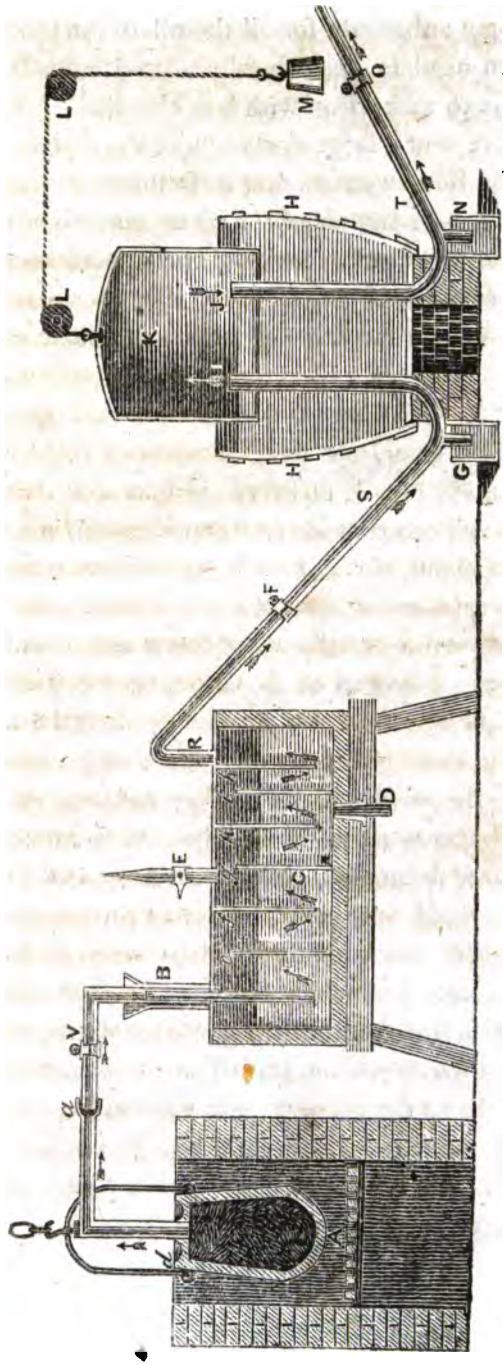
Fig. 5 shows a section of one of the gas lamps. The space between the outer tube T and the inner tube V, is to be filled with gas supplied by the pipe R, shown in fig. 1, where a stop-cock is inserted for adjusting the flame, which gas passes through a number of small holes made in the outer edge of a circular plate, shown at fig 6, which unites the tubes T and V at their tops. V is the inner tube, which conveys the atmospheric air into the centre of the flame: the upper part of this tube is made conical, or widening outwards, to join a circular plate with holes in it, a horizontal view of which is shown at fig. 6. W is a button, which can be placed at a small distance above the mouth of the lamp, and its use is to convey, in an expanded manner, all the air which rises through this tube to the inner surface of the flame, which assists the combustion very much; this button may be set in any convenient distance above the tubes of the lamp, as it slides in the cross bars X X, by which it is supported in the inner tube.

A current of air also passes between the glass tube or chimney and the outer tube T, through holes made in the bottom of the glass holder, as in Argand's lamps: this surrounds the flame, and completes its combustion, as explained by the view, fig. 3, and section, fig. 4, which have a glass upon each. Z Z Z Z, figs. 3, 4, 5 and 6, show the tube through which the lamp is supplied with gas from the pipe R, fig. 1.

Method of producing Heat, Light, and various useful Articles, from Pit-Coal. By Mr. B. Cook, *of Birmingham**. Plate 3.

Sir—Having paid much attention to the procuring of gas and other products from pit-coal, I now beg leave to lay before the Society for the Encouragement of Arts, &c. the results of some of my experiments on pit-coal, and the methods of procuring the sundry articles of which I have sent samples, and a japanned waiter varnished therewith. The quantity of clear tar which may be produced from every hundred weight of coal is about four pounds, from which a liquor, or volatile oil, may be distilled, which answers the purposes of oil of turpentine in japanning. Every gallon of tar will produce nearly two quarts of this oil by distillation, and a residuum will be left nearly, if not quite equal, to the best asphaltum. I have sent a waiter, or hand-board, japanned with varnish made from this residuum, and the volatile oil above mentioned. This dries sooner, and will be found to answer as well as the best oil of turpentine, a circumstance which wil be of immense advantage to this country, as in the vicinity of Birmingham only, nearly ten thousand tons of pit-coal are coked or charred per week; and all the tar hitherto been lost; but by my process, I dare venture to say, that from the various coal-works in this kingdom, more tar might be produced than would supply all our dock-yards, boat-builders, and other trades, with tar and pitch, besides

* From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1810.—The Society voted their silver medal to Mr. B. Cook for this invention.


L
L
M
O
T
N
H
H
K
G
S
F
R
E
D
C
B
V
a
A

furnishing a substitute for all the oil of turpentine and asphaltum used in the kingdom, and improving the coke so as to make iron with less charcoal.

I have sent a large specimen of the asphaltum, and three phial bottles containing as follows:

No. 1.—A sample of the oil or spirit, being part of that which was used in making the varnish with which the waiter sent was japanned.

No. 2.—Is the same oil or spirit, a little more rectified.

No. 3.—The same, still further rectified, and of course more clear, and freer from smell; but I find that the specimen, No. 1, answers quite as well for varnish.

Tar-spirit is now about 8*s*. per gallon, and turpentine-spirit about 15*s*. This latter has been, within the last two years, as high as 48*s*. per gallon, and the tar-spirit will answer equally well for varnish, on using the coal-tar-spirit, instead of the turpentine spirit.

I requested Mr. Le Resche to use the tar-spirit just in the same way he would the foreign spirit, and then give the varnish to his work-people to use, without making any remark to them, which was done: he making the varnish himself, found it mixed, and made the varnish as good in appearance as that prepared with the foreign spirit. He then gave the varnish to his work-people to use; and when they had finished their work with it, he found from their report, that it answered perfectly, and dried sooner; and when the waiter done with it was given to the polisher, it was found to polish much smoother under the hand, and take a more beautiful gloss than their former varnish, as the article now sent will show on inspection.

I am of opinion that the production of these articles will be of great public service. Permit me to add, that the timber of ships payed with this tar is not nearly so liable to be worm-eaten as those done with common tar.

I remain, sir,

Your humble servant,

Birmingham, Jan. 12, 1810. B. COOK.

To C. Taylor, M. D. Sec.

Reference to Mr. Cook's *Apparatus for preparing Gas and other Products from Pit-Coal.*

A. Fig. 1, Pl. III, is a common fire-place, a stove built with brick, having cast-iron bars to put the fire in at, and a flue that goes into a chimney; A is the cast-iron pot, (which holds from twenty-five pounds to one hundred pounds of coal, according to the size of the premises to be lighted) which hangs by the bewels or ears on a hook, suspended by a chain in this stove or furnace, about three inches above the bars of the grate, and three inches distant from the sides of the stove; the fire then flames all round this pot, and as it does not rest on the burning fuel, it is the flame only that heats it, so that it does not scale, but will last for years. The smoke, &c. is carried off into a chimney. The cover *d* of the pot is made rather conical, to fit into the top of the pot close, and from the top of the cover the elbow-pipe proceeds as far as the mark *a*. The other end of the pipe with the elbow entering the water-joint is rivetted to it after; when the lid or cover of the pot is put on, the bewels or ears come over the elbow of the pipe that is on the lid, and a wedge is put between them and this elbow, to keep down the cover air-tight, and a little clay or loam may be luted in the joint, if any gas should escape round the cover of the pot. The other elbow B goes into a water-joint, formed of a tube affixed to the cover of the purifier C; and another tube, which passes through the lid of the purifier: the elbow-pipe then goes over the inner tube, and when put on, the jointing is made good by pouring water into the space between the tubes, which renders it air-tight. The gas, as the arrows show, passes down into the purifier C, which is rather more than half full of water; the use of this water-joint is for the convenience of removing the lid *d*, to which this pipe is attached. The purifier C is a wooden trough, with a sheet-iron top, to which the tubes are soldered, and it is fastened to the trough to keep all secure and air-tight. The sheets of iron, *e*, *f*, *g*, *h*, *i*, *k*, are alternately soldered to the iron top, and fastened to the wooden bottom. Now when the trough is half filled with water, the gas passes into it at B; and as it can only find its way out again at R, it must pass through the water. The inner pipe B reaches under the surface of the water in the trough, now when the gas is forced into the water, it would rise to the top of the purifier, and go along in a body to the end, and out at the pipe R, if the sheets of iron, *e*, *f*, *g*, *h*, *i* and *k*, which stand across the trough with openings in them, alternately at top and bottom, did not stop it, force it to descend down into the water, and hinder it from going any way but through these apertures, purifying it all the time it is passing through the whole body of water, until it is properly washed: it then escapes through the pipe R at the end of the trough C, then passes down the pipe S, and is carried up into the reservoir or gasometer K. In the bottom of the purifier is an aperture, closed by a plug at D, to let off the ammoniacal water and tar as it is deposited, and the pipe with the cock E at the top of the purifier, is to burn away the spare gas when not to be used.

There is a stop-cock placed in the main pipe at F, that when the reservoir is full, and gas is making, and cannot be used, the cock may be turned, and prevent any gas from passing from the reservoir; and by opening the cock E on the top of the purifier, and firing it, all the gas which is made more than is wanted for use may be burnt away. If this was not done, the gas would continue to find its way into the reservoir K, which would overflow, and produce a disagreeable smell, which this simple way of burning it away as fast as it is made when not wanted, prevents.

It may in some measure happen, that although the gas has passed through the purifier C, yet that a small portion of tar will pass along with it, and would either clog the pipe S, or accumulate in the reservoir. To avoid this, there is placed at the bottom of the pipe S at G, before it rises into the reservoir, a jar into which a pipe made, as shown in the drawing, conducts the tar; this collects all that passes through the purifier; it is filled with water, over which the gas passes up into the reservoir, but the tar drains down this lead pipe and deposits itself in the jar of water. The longer this pipe S is, the better, as it serves as a refrigeratory. H is a plain cask, made to any proper size, and filled with water, with a cock to draw off the water when it becomes foul. The upper vessel K is made of sheet iron, rivetted together in the manner engine-boilers are made. If it is only from five hundred to one thousand gallons in size, it will require only two iron cross bars at top, and four ribs down the sides to keep it in form, with a strong ring at top; and as there is no stress on this vessel, it will ascend and descend easily without any other support or framing, the plain sheet iron sides being rivetted to the four ribs, and it is quite open at the bottom. A strong rope runs over the pulleys L L, with a weight M to balance the vessel K, and assist it in rising and falling. The pipe J is that through which the gas passes from the reservoir or gasometer, and rising through the pipe T, is conveyed to all parts to be lighted. There is also another drain pipe at N, for after all the washing, &c. a very small portion of tar and moisture may rise into the pipes, and perhaps in time clog them; but by laying all the pipes in the first, second, and third stories on a small descent, if any tar or moisture should rise, it will drain down all the pipes from top to bottom, and be deposited in the earthen jar at N: by that means the pipes will not clog up in half a century. These jars must be sometimes removed and emptied, fresh water put in, as also the water in the vessel H must be changed, to keep it clean and sweet; and the water in the purifier C should be changed every two or three days; by these means the gas will be deprived of all its smell, at least as far as washing will effect it, and the apparatus will be clean.

The stop-cock at O is for the use of a master, if he wishes to lock up the gas in the reservoir, to prevent his workman, &c. wasting it in his absence; as also if any pipe should leak, or a cock be out of order, in any part of the premises, by turning this cock all the gas is kept in the reservoir while the pipe is repaired, or any other alteration made; it also extinguishes all the lights when turned, if any are left burning by careless workmen, nor can they be lighted until it is opened again.

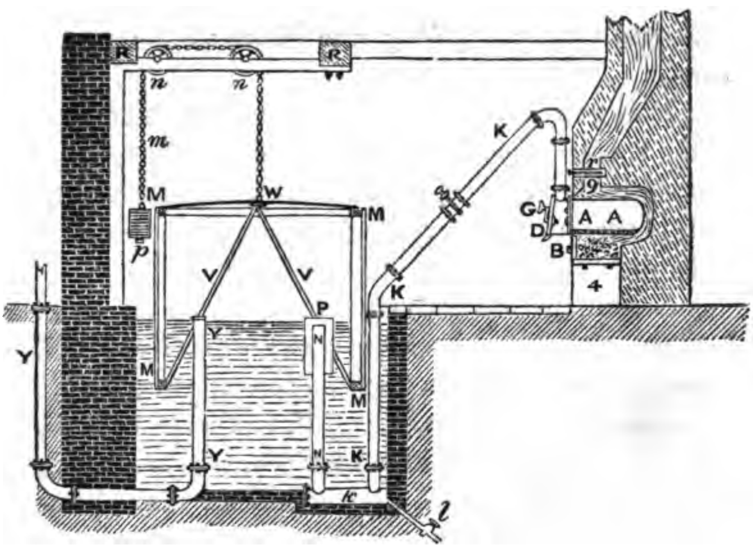
The whole of this apparatus is simple, and not liable to be put out of order in such a way, but that any person may put it to rights again. All the art required to make the gas is to take off the cover of the pot, and without removing the pot to take out the coke, and fill it with fresh coal, wedge it down by putting an iron wedge between the bewels or ears and the elbow of the vessel, and if required, plaster a little clay or loam round the cover, to keep it air-tight; a fire is then made under it, and the whole is done. The boy or man who does it, must now and then look at the fire and keep it up, until the pot is hot, and the gas is made. Now in works where lights are wanted almost always, I would recommend two fire-places, and two pots, so that when one pot is burned out, the other pot may be ready to act; for this purpose the purifier must be provided with two of the water-joints B, one communicating with each pot, and the elbow-pipe of each pot must have a stop-cock, as V: now when one pot is burning, the cock in the other pipe must be stopped, that the gas may not find its way out of the purifier; and when all the gas is extracted from that pot, the cock C, leading from it, must be stopped, and the pot left to cool; while a fire is put under the other pot, its cock is opened, and a supply of gas from it is passed into the reservoir: by these means one of the pots is constantly supplying the reservoir with gas, and the lights are always kept burning; one purifier is all that is necessary; the cock V must be shut when either of the covers is taken up to fill the pot again with coal: when the elbow-pipe is lifted out of the water-joint, as the cover is attached to it, a plug must be provided to fit into the water-joint pipe the moment the elbow is removed from it, or the gas will rush out of the pipe at the water-joint; but a better way would be, to lengthen the pipe of the water-joints B, and place a large cock under each of them, almost close to the top of the purifier; when one pot is burnt out by turning the cock it keeps all the gas in the purifier while the cover is removed: no plug is necessary in this method. When people are very particular, (especially when houses or accompting-houses are to be lighted,) and wish all smell to be destroyed, if they are not satisfied with washing it, and still think there is a little smell left, (and very little indeed, if any, will be left) after the washing, a small trough may be added, made in the same way as the purifier, with sheets of iron across to force the gas through the pipe R communicating with it. This trough may be filled with water, with a few lumps of lime put into it, and this water and lime changed often. On the gas being forced through this lime-water, if there was any remaining smell in it, this would completely take it away; and, as has been before observed, by changing all the waters now and then, and keeping this small trough constantly supplied with clean water and lime, the gas after passing it will ascend the pipes to the lights pure.

Plan of Gas Light Apparatus.

[FOR THE MONTHLY MAGAZINE. JAN. 1815.]

THE attention of the public being properly directed to the system of lighting our streets, roads, and houses, by a nearer approach to the principle of inflammability, than is afforded by the compound substances of oil and tallow, we comply with the wishes of many correspondents, and with the anxious curiosity of the public at large, in giving place to an account of a simple gas apparatus, as they have been and may be consructed to light a manufactory, a public edifice, a village, or a small neighbourhood.

THE GAS LIGHT APPARATUS.



The structure of the gas apparatus will be readily understood from the above diagram. It represents a section of the whole through its centre.

A A is an iron retort, about three feet long, and two feet diameter, open at the end B, to which is screwed, by means of a flaunch, a door-piece; to this the door D is applied, and is shut close by a screw G, applied in the centre.

The coals to produce the gas are shut up in the retort, and the whole is heated to redness by a fire applied underneath it, upon the grate 4, the retort being placed in a sort of oven or furnace, so that the heat surrounds every part of it, except the mouth B, or part at which the coals are introduced.

Around is the space of this oven, and 9 is the flew leading from it to the chimney, the aperture of which is regulated by the little damper *r*.

Under A A is a plate of cast iron, preserving the retort from being injured by the intensity of the fire underneath it, and causing it to be heated more uniformly.

K K represents the cast iron pipe, which conveys all the volatile products of the coal to the refrigeratory of cast iron *k*, in which the tar, &c. extracted from the coal, is deposited, and from whence they can be drawn off by means of the copper pipe at *l*.

N is a pipe which conveys the gas from the vessel *k*, to the top of the cylindrical vessel or receiver P; this receiver is air-tight at the top, and consequently the gas displaces the water in the vessel P, to a level with the small holes made round its inferior edges, where the gas is suffered to escape, and rises in bubbles through the water of the well into the receptacle or gasometer M M M M.

This gasometer is made of wrought-iron plates, and is capable of rising as in the figure, or of sinking down nearly to a level with the top of the well, which contains the water, when it will consequently be nearly filled with water; but it rises gradually as the elastic gas enters it from the pipe N, and displaces the water; the weights *p*, suspended over pullies *n n*, by the chain M *m n n* W keep it steady and balance it.

There are two sets of iron stays, or arms, shown at V V, to strengthen the gasometer within side.

The seams of the gasometer are luted to make them air-tight, and the whole is well painted inside and outside to preserve it from rust.

The pure gas from the gasometer enters the tube Y at the small holes made in its top, and passing on through the tubes Y Y Y and Y, it is conveyed by other pipes from this to the burners, or lamps, where it is to be consumed.

The burners are formed in various ways, either by a tube ending with a simple orifice, at which the gas issues in a stream; and, if once lighted, will continue to burn with a steady and regular light, as long as any gas is supplied. At other times a number of very minute holes are made in the end of a pipe, which form as many *jets de feu*, and have a very brilliant appearance.

The use of the *gasometer*, is to equalize the emission of the gas, which comes from the retort more quickly at some times than at others. When this happens the vessel rises up to receive it, and when the stream from the retort diminishes, the weight of the gasometer expels its contents, for the balance-weight *f f*, should not be quite so heavy as the gasometer, in order that a suitable pressure may be exerted to force the gas out at the burners with a proper jet. The gasometer of the original company, in Westminster, has a capacity of 15,000 feet: the Blackfriars company have two of 8000 feet.

The remains which are found in the retort, after the process is finished, consist of most excellent coke, which, in value, for culinary fires, or manufactories, returns a considerable portion of the whole expenses.

When the retort cools, the vessel P contains a sufficient quantity of gas to supply any absorption which takes place, without raising the water into the retort.

The erection of an apparatus, such as is represented above, will cost from 100*l.* to 150*l.* and if its gasometer is five feet diameter, by seven feet high, it will contain a sufficient quantity of gas, at four cubic feet per light, per hour, to give forty hours' light to a brilliant Argand lamp, or five hours' to eight lamps, equal in intensity to one hundred and sixty common street oil lamps.

Such a gasometer will be filled by the distillation in the retort of about half a bushel, or a quarter of a hundred weight, of coals.

It is usual, and for in-door lights it is necessary, to pass the gas, after it leaves the deposit vessel, before it reaches the gasometer, through a vessel of lime-water, so as to deprive it of all bituminous and sulphureous smell. This is not represented, but it may be easily conceived to form part of the communication.

It would be unnecessary to remark on the safety and innoxiousness of this apparatus and mode of lighting, if the bigoted enemies of all improvement were not conjuring up every conceivable objection, and exaggerating every error of ignorance, in the first introduction of a great discovery. For example, it is said that a workman recently took a lighted candle into the gasometer and blew it up. But every person will feel that such an accident was a necessary consequence of so inconsiderate an act. No use of the apparatus requires a candle in the gasometer, and the lighting of a fire on a wooden staircase, and the applying a candle to the curtains of a drawing-room, are as valid objections to our culinary fires, and to the use of candles, as any such act as that of carrying a lighted candle into a gasometer is to the use of pure gas in lighting our streets and houses.

Most of that enlightened class of manufacturers called machinists will undertake to construct this species of apparatus; but a reference to Messrs. Grant, Hargraves, and Knight, of Blackfriars, London, will afford the most certain resources to public bodies, and others, who are disposed to introduce this mode of illumination.

Melville's patent improved Gas Apparatus.

I THINK it right to insert this plate and description, because it is the subject of an American patent. Taking out patent rights has become a most disgraceful and demoralizing speculation. I am utterly ignorant upon what pretences Mr. Melville could take out this patent, or how he could go through the necessary ceremonies prescribed by the act of congress for the purpose. I see nothing in the plan to authorize the patent.

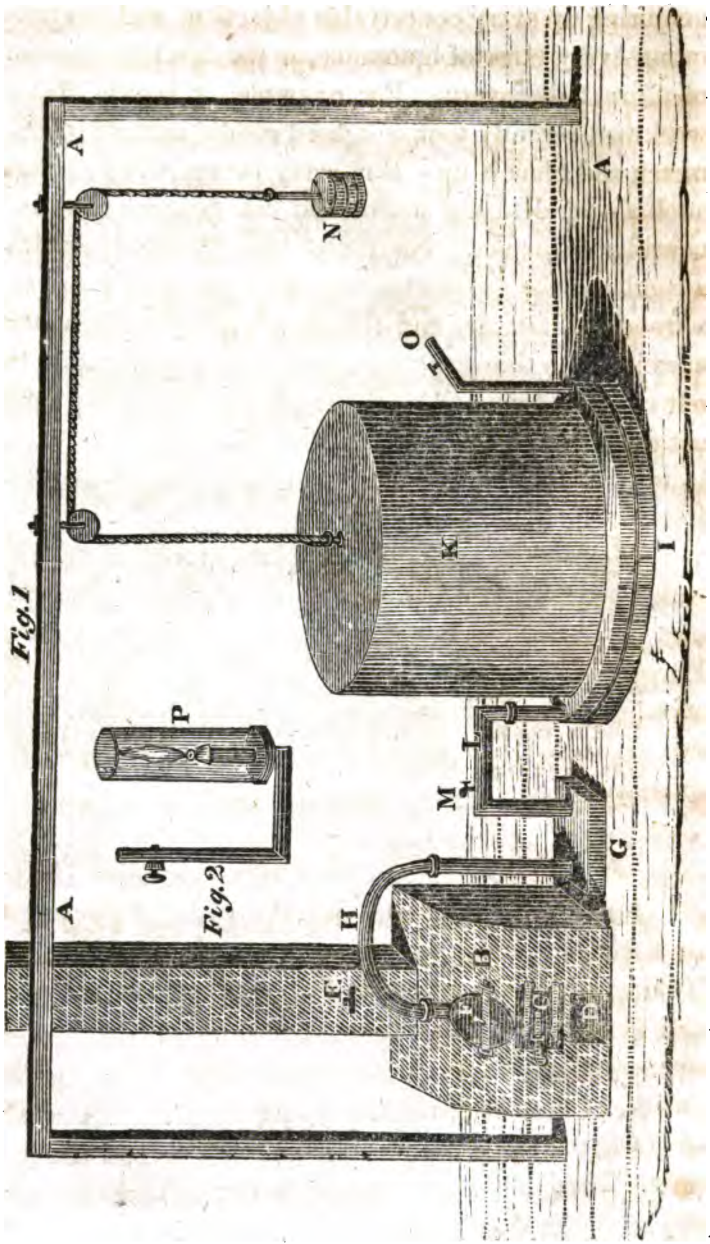


Fig.1
Fig.2
A
A
A
N
O
K
I
P
L
M
G
H
E
B
F
C
D

REFERENCES TO THE PLATE.

Fig. 1. A A A. The floor, and part of the structure of the gasometer house.

B. A furnace in which a retort is set.

C. The door of the furnace, where the fire is placed.

D. The ashes hole.

E. The damper, or register to regulate the draught of the furnace.

F. A cast iron retort, with the door fixed on, in which the coal is put to produce the gas.

G. The condenser and bath.

H. A pipe which conducts the gas from the retort to the condenser and bath, where it passes several times through the water, by which it is washed and purified.

I. A cistern set in the ground, and kept filled with water, by means of an aqueduct, the water from which passes through the bath, to a drain from the gasometer house.

K. The gasometer, or reservoir, which is suspended in the cistern of water by a rope or chain leading over pullies.

L. A pipe which conducts the purified gas from the condensor, through the water in the cistern, to the gasometer, where it is reserved for use.

M. A stop-cock, to let off the gas until it becomes inflammable, and to burn it from, when the gasometer is full, to prevent its escaping underneath.

N. A balance of weights, to hold the gasometer in suspension, and (by taking off one or more of the weights) to give force to the gas when necessary.

x

O. A pipe which conducts the gas from the gasometer house to the apartments where the lights are wanted, where it issues from the burners, and, on the application of a taper, will burn with a brilliant flame, without smell or smoke. The burners are fitted with keys by which the flames may be regulated, or instantly extinguished, which operation may be performed on the whole at once, (be there ever so many) by means of a single key in the main tube.

Fig. 2. P. The form of the burner from which the gas issues, with the tube glass, and key to regulate the flame, (on a larger scale.)

SPECIFICATION OF THE MODE OF OPERATION.

A quantity of coal, in proportion to the number of lights required, must be placed in the retort, and the door screwed on and luted tight with a lute of clay and sand; this done, a strong heat being applied by means of a fire kept up in the furnace, hydrogenous gas, or inflammable air, will be driven out of the coal confined in the retort, and forced through the water in the bath, in which the condenser is immersed; by passing through the water, the bituminous matter, which is a component part of the coal, is separated from the gas, which is washed and purified. From the condenser, the purified gas is passed by a pipe, through the water in the cistern, to the gasometer, where it may be reserved for use. As the gas passes in, the gasometer will be raised up until it is filled; when full, (to prevent the escape of the gas underneath, and the smell which it occasions when it issues without burning) it may be burned from the cock on the pipe, which leads from the condenser to the gasometer. When the lights are required, by taking one or more weights off the balance, the gasometer will bear with so much the greater force on the volume of gas contained in it, by which it will be propelled through the pipes to any distance, and in any direction, to the burners, which are situated where the lights are wanted. Immediately on the issuing of the gas from the aperture of the burner, and coming in contact with the oxygenous gas of the atmospheric air, it will take flame on the application of a taper, and burn with a brilliant light, without smell or smoke, as long as there is any gas in the gasometer. The burners are fitted with keys, by which each separate flame may be regulated to give more or less light at pleasure, or be instantly extinguished; and the whole (be there ever so many) may be regulated as to the size of the flame, or they may be instantaneously extinguished by turning a key in the main tube.

The quantity of coal required for any given number of lights will vary with its quality. The usual quantity is about forty pounds for fifty flames, equal to that of a moulded candle of six to the pound, to burn three hours. Two pecks of coal, weighing forty pounds, put into the retort, will leave a residuum of near three pecks of coke, weighing twenty-eight pounds. The coke is better for many uses than raw coal, and, if used in the furnace, will be nearly sufficient fuel for each succeeding operation.

Before I proceed to offer my own variations from these processes, I would beg the reader to consider the process of distilling coal again in detail.

The products of the distillation are—first, the gases—secondly, the liquids—thirdly, the residuum, or coke.

The gases and liquids come over together; but they must be separated, by condensing the liquid products, and permitting the gases to escape. This condensation can only take place by exposing the mixed stream of uncondensible gases and condensible vapour to cold: for if the gas that is not condensed is permitted to hold in solution much of the empyreumatic oil distilled over, and which ought to be condensed in an early part of the process, the gas, when burnt, will certainly be offensive to the smell. Some of this oil, to the point of chymical saturation, it holds permanently dissolved, and much of the brilliancy of the flame depends on it; but it is capable of supersaturation with this oil, and then an empyreumatic smell is produced, when the gas is burnt.

Suppose this tar, oil, and ammoniacal liquor, condensed, as it ought to be, as quick as possible after it comes over:—then the gases evolved escape freed from the liquid products. These gases are—first, *carburetted hydrogen*, or the proper inflammable coal gas;—secondly, *sulphurous gas and sulphuretted hydrogen*, from pyritous matter contained in the coals, and which would occasion an intolerable smell;—thirdly, *carbonic oxyd*, which is incombustible; and, fourthly, *carbonic acid*, which is also incombustible. These gases are separated by caustic potash, or, more cheaply, by well burnt quick-lime, mixed with water to the consistence of cream. This mixture must be agitated by a stirrer, to prevent the lime from settling, and to expose more surface of lime water to the extricated gases; which ought afterwards to be washed by a portion of water in the fixed vessel wherein the gas-receiver is inverted.

In Mr. Parke's apparatus, there is no provision for washing the gases in lime-water, to separate the incombustible carbonic acid, and the fœtid sulphuretted hydrogen.

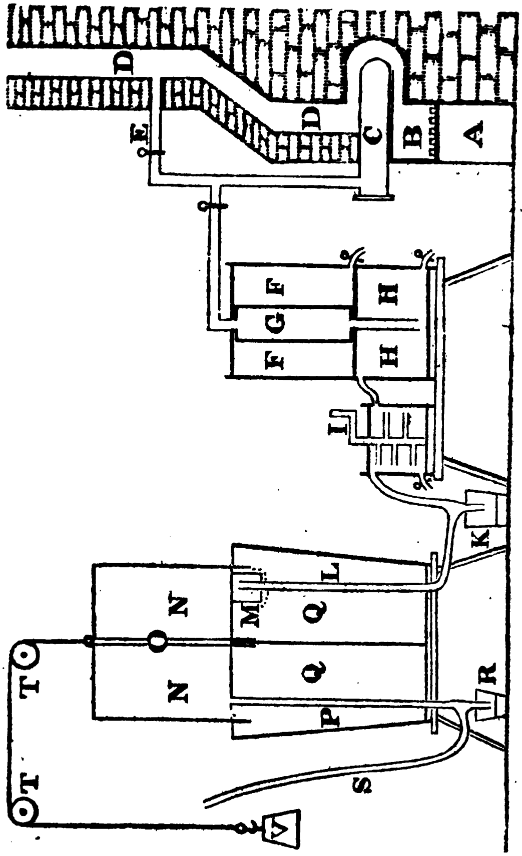
In Mr. Cook's apparatus, there is no provision for previously condensing the products of the distillation capable of condensation; but they appear to intermingle with the lime-water, and no doubt to spoil it quickly.

Mr. Clegg's apparatus has no lime-water tub; nor has the apparatus recommended in the Monthly Magazine for January, 1815.

These appear to me important omissions, which I have supplied. Doubtless the manager can make shift without the lime-water, and without the condensing vessel, using common water only, but the gas can never be relied on in this case as pure. Nor is it prudent to risk the odium on a plan so truly desirable, which these omissions would inevitably produce, where either coal or wood are employed to produce the gas in question. If, as I believe, pitch will answer, on a small scale, in point of expense, almost all the difficulties will be removed. For lights in high situations, as light-houses, the lime-water and the common water may both be dispensed with, and the gas burnt as it issues from the empty vessel destined to condense the smoke. This was the process of *Mr. Henfrey*, and is the simplest method of exhibiting the gas, where the empyreumatic odour emitted is of no consequence.

After making these remarks, I would propose the following method of obtaining coal gas, which I consider as an improvement.

Mr. Cooper's proposed method of obtaining Coal Gas.
Plate 6.



A. The ashes hole.
B. The fire place.
C. The cylinder containing the coal.

D. D. The flue of the chimney.

E. A pipe through which the vapour and gas, which escapes during the first ten minutes, and which is mixed with carbonic acid gas, is suffered to escape into the chimney: the cock at E is then turned, to shut the communication with the chimney, and the cock below it opened, to leave a free passage for the gas to escape into G.

Also, when the coals are drawn out of the retort when the operation is over, the offensive gas, which in London is permitted to escape out of the retort into the air of the chamber, is by this contrivance sent upward into the chimney at D, by opening the cock E, and shutting the cock below it. There it may burn away till no more remains.

F F. A vessel containing water, to be supplied for condensing the tar and oil that passes down the pipe G, which is surrounded by the water in this flake-stand. When warm, it can be let out by the cock below, and renewed.

G. The pipe down which the vapours and gas from the coal pass into the vessel below H H.

H H. A recipient, to receive the condensed oily and tarry vapour that accompanies the coal gas; when full, the liquor can be drawn off by the cock below. The uncondensed gas escapes into the next vessel by the upper tube.

I. A flyer with arms, to agitate the mixture of lime and water in this vessel, and expose new surfaces to the contact of the gas. The vessel being filled with water and lime, to the consistence of cream, the agitator stirs up the lime-water, which absorbs the carbonic acid gas, and much of the empyreumatic oil and tar held in solution by the coal gas. The vessel is provided with a cock to empty the lime-water, when the lime becomes effete. This is the only stinking part of the process that must be submitted to in part: even this may be greatly lessened by letting off this lime-water, thus impregnated with oil and tar, by means of a drain, that opens *under* water; in this way the air is not affected by it. The pure gas escapes by the upper tube.

K. A vessel, wherein any tar, brought over by the coal gas, may be deposited before it enters into the receiver. R is a vessel of the same kind, for the same purpose, viz: to be quite sure that all the useless oil and tar, not held in chymical solution is deposited.

L. The pipe up which the gas ascends into the water.

M. Holes through which the gas is forced to pass, through a column of about an inch or two inches of water, before it enters into the gas-holder.

N N. The gas-holder.

O. A pipe fixed to the top of the gas-holder, which slides up and down the pipe fixed in the cistern below, and serves to keep the motion of the gas-holder steady.

P. The pipe down which the washed coal gas passes, when the gas-holder is depressed.

Q Q. Water in the lower vessel, wherein the gas-holder is immersed when not filled with gas.

R. Vessel to receive any deposit of tar that may still remain in the gas, and be separated by standing or condensation.

30

S. The pipe through which the washed gas ascends, and is distributed to the various burners.

T T. Pullies over which the rope or chain attached to the gas-holder moves, to diminish friction.

V. The weight serving as an equipoise to the gas-holder.

The gas-holder will have a different weight when it ascends full of gas, from what it has when it is immersed in the water. This weight may be compensated by the length of chain between T and T, as is obvious. But it requires some few experiments to adjust that, which are easily made. For it is evident that the gas-holder will grow heavier as it rises out of the water, and the counterpoise will also become heavier according to the increased length of the chain on the side T, V, when the gas-holder rises.

Accum's mode of adjusting this, borrowed from Mr. Clegg, is as follows.

Method of correcting the relative pressure of the Gasometer, so as to cause the gas which it contains to be uniformly of an equal density.

We have mentioned already that the pressure of the gas in the gasometer should be invariable; for it is obvious that the weight of the gasometer is constantly increasing, in proportion as it fills with gas, and rises out of the water. To render its pressure uniform, we first take the *absolute* weight of that part of the gasometer which becomes immersed in the water, and knowing the *specific weight* of the substance of which it is composed, we divide its absolute weight by the specific weight of the substance of which it is composed; and this being done, we make part of the chain, (measured at right angles from the axis of the wheels, over which it passes downwards, towards the top of the gasometer) which is equal to the length of that part of the gasometer which becomes immersed in water, equal in weight to the specific gravity of the substance of which the gasometer is composed. For example—let us suppose that the part of the gasometer which becomes immersed in water weighs 861lbs. and that it is composed of sheet iron, the specific gravity of which, in round numbers, we will take to be 7. It is then evident, that the part of the chain of the gasometer, measured downward from the axis of the wheel over which it passes, and which is equal in length to the height of the gasometer, must be loaded with a weight of, or must itself weigh, 123lbs. for this would be the weight of the water displaced by the gasometer; or let us suppose the gasometer to be made of sheet copper, the specific weight of which (omitting decimals) is 8; and that the absolute weight of the gasometer is 1792lbs. then the chain of the gasometer, equal in length to the height of the gasometer, immersed into the water, must weigh 224lbs. for this would be the weight of the quantity of water which the gasometer displaces. This being accomplished, by then adding or diminishing the absolute or balance weight of the gasometer, any desired uniform pressure may be effected, and the same bulk of gas will always be of the same specific gravity.

If the coal gas be not well washed in lime-water and common water, it will hold in solution some empyreumatic oil, which gives out an unpleasant odour when burnt, and some sulphureous as well as carbonic acid gas, which deteriorates the light. It is for this reason I employ with Mr. Parke's a pipe to convey into the chimney the products of the first ten minutes distillation. But I think the flame is more vivid if the gas be not too much washed: it is the brighter for containing a small portion of oil; and it is brighter also when used fresh, than when it has stood for some time; for after some days too much of the dissolved oil is deposited.

A chaldron or 36 bushels, or from 2800 to 2900 lbs. weight of Newcastle coal, affords 10,000 cubic feet of this gas. Cannel coal of Wigan in Lancashire, furnishes much more. In a small way, a pound weight of coal will furnish from two and a half to three cubic feet. On an average, the coal employed as fuel to distil the coal enclosed in the retorts, amounts to about half the weight of the latter. The expense is very little when the establishment is once made, and the coke, the tar, and the ammoniacal liquor, almost pay the expense (in England) of the coal used. One cubic foot of gas per hour, will supply a light equal to three candles of common size.

The establishment, however, is so expensive, that it will answer only on a large scale. The interest of the capital laid out will be far more than the savings on a small scale. For churches, for theatres, for manufactories, it may afford a cheaper light than oil or candles, even from pitch; but it would hardly prove economical in private houses, to erect a separate apparatus for the purpose.

The pipes or mains in the London streets cost 1200l. sterling per mile; the contractors furnish a light to private families, that equals four candles of about 8 to the pound, for three guineas per annum; which is certainly so low, as to admit but of a moderate profit.

The precautions necessary as stated by Accum, are these:

*Directions to Workmen attending the Gas Light Apparatus.**

Particular care must be taken to make the joints of the mouth-pieces of the retorts perfectly air tight, which may be done in the following manner:—Take some common clay, dry, pulverize, and sift it, then add as much water as will make it into the consistency of treacle; make the mouth-piece and the lid of the retort clean, lay this luting thinly over the turned part of the lid, press the lid so luted gently to the mouth-piece, and then secure it moderately, by means of the iron wedge: if the workman observes this rule, he will never fail to make good joints; but if, on the other hand, the operator is careless and neglects to remove the old luting, &c. from the turned or smooth part of the mouth of the retort, and thereby cause a bad joint, the consequence will be the loss of a considerable quantity of gas, and a very disagreeable smell and smoke.

The bridge or row of bricks of the flue c, of the retorts, should never be made hotter than a bright red, which may be regulated by the door of the ash-pit being kept close shut when the fire is getting too hot. If

* Copied from a printed direction drawn up by Mr. Clegg. for the use of workmen.

the operator neglects this, and suffers the fire-bricks to arrive at a bright white heat, the retorts will soon be destroyed, and bad gas be produced.

The gasometer should be well examined, at least once a week, to see if it leaks, by the following method, viz. Let the main stop-cock be shut, then make a mark on the gasometer at the water's edge when it is full or nearly of gas, there being no gas coming from the retorts at the time, and if the mark sinks in the water, the gasometer leaks; to find out the place, walk slowly round it, and you may perceive the leak by the smell, apply a lighted candle to the part suspected, and if there be gas issuing from it, it will take fire, and perhaps appear like a small blue flame—blow it out, and mark the place: thus proceed round the gasometer till you have found all the places; if you perceive a smell, and yet cannot produçe a flame in the part suspected, take a brush with a little thin white-lead paint, and lay it on the part where you think the leak is, and, if it be there, the gas which escapes from the leak, will immediately turn the paint brown. After the sides of the gasometer have been well examined, and secured by dipping a piece of cloth about the size of a shilling, into some melted pitch, tempered with a little bees-wax and tar, apply the cloth whilst hot to the place with the end of your finger, rubbing it till it is quite cold; next examine the top of the gasometer in the same manner—when it is about two feet high in the cistern, it will then be better to get at. The water in the cistern should always be kept within 3 or 4 inches of the top, if suffered to sink much lower without replenishing, the gas will not pass through a sufficient quantity of water, and oily particles will be apt to condense in the pipes, to their great detriment.

The only thing to be observed in the place lighted is, that the lamps and pipes are not suffered to be touched on any pretence whatever, but by the person entrusted with their care. When a lamp is not wanted, it must be completely shut off from the pipe which supplies it, by a stop-cock provided for the purpose, and not opened again but when a flame is held over it; not a lighted candle, as the tallow is liable to drop into the lamps; lighted paper is better.

The following precautions will also be found equally necessary.

1st. In the first instance, to take care that all the common air is driven out of the pipes by the current of coal gas; else it may take fire and explode without burning: though when once the current of gas takes place and is kept up, there is very little danger of explosion.

2dly. That the stop-cocks shall be very close and accurate for the same reason, as well as to prevent the escape of the gas.

3dly. To take care, that the coal gas permitted to escape in the first instance, for the purpose of driving away before it the common air, shall be carried out of the room by ventilation, before any candle or light be brought in.

4thly. Before the gas is lighted, if any common air be suspected, smell at the gas, which will generally indicate whether it be entirely carbonaceous. Keep the stop-cock shut, while you inflame the gas above, if you have any suspicion: or you may by means of an inverted tube receive the suspected gas from the burner into a receiver of water, and then try if it explode. These precautions are hardly necessary, except at the first lighting of the gas, and when the contained common air has to be driven out. Afterward, the pipes are kept continually filled with coal gas.

5thly. Receptacles should be provided for the water formed by combustion.

6thly. It is doubtful yet whether the metal tubes may not be liable to be acted on, by an acid evolved with the coal gas, and imperfectly separated.

7thly. Very small pin holes, or holes sufficient only to admit the point of a small needle, will be found large enough: when larger the point of the flame is brown, smoke arises, and the combustion is incomplete.

These difficulties are not stated by Accum, from whose late work I have borrowed some of the facts of this paper, but which though useful is very imperfect; though very expensive.

Liverpool coal has afforded me somewhat more gas than Virginia coal; but this last will answer. Pine saw-dust also affords a gas almost as good.

In Pennsylvania, the coal region does not begin till you arrive at what mineralogists would call the commencement of secondary formations. This coal region is divided into two great districts. The one is, to the east and north-east of the north-east branch of the river Susquehanna, reaching from the heads of Lackawanna, Lehigh and Schuylkill, past Orwigsburgh on the Reading side, and six or eight miles below Sunbury, on the Harrisburg side. This coal is properly stone coal, (anthracite), similar to the Kilkenny coal: it yields little or no flame; no smoke; a little sulphur, makes a very hot fire, difficult to be kindled without a blower; and is indeed a species of graphite, chymically similar to black lead. This coal will do for furnaces or large fires, but it will yield little or no coal gas. It would be well worth to try it in air furnaces, and for iron works, for which the charcoal made by distilling coal for coal gas, is also excellently well adapted. My full conviction of this has induced me to insert so much of the examination before the committee of the house of commons. The other great division of coal formation, in Pennsylvania, is on the west and to the north and west, of the west branch of the Susquehanna; extending into the Indiana territory, and down the Ohio. This is the coal of Juniata and of Pittsburgh. It is bituminous: burns with smoke and flame: yields much coal gas; and is, I *believe*, (for I have not traced it) the same formation, and connected with the Virginia coal, which however seems not quite so good for the purpose, as that of Pittsburgh, but will answer sufficiently. The shining primitive anthracite of Rhode Island will not do.

From a conversation with Mr. Dowers, I am strongly induced to think with him, that in this country, in a large establishment, wooden gas holders would be preferable to sheet iron. They can be made more permanently air tight—of less weight—cheaper—less liable to be corroded—they need no painting, and are more easily renewed or replaced. I greatly doubt whether any coating, in the form of paint, or pitch, will permanently stick on sheet iron, and prevent its oxydation and corrosion.

When it is necessary to save the expenditure of water, or to save the weight of the body of water in the vessel wherein the gas-holder is immersed, this can be managed by filling the inside of the vessel into which the gas-holder descends, with an air tight wooden box or case, that shall nearly fill the aperture of the gas-holder, so that this last shall move up and down in a body of water of about three inches only, when the gas-holder is sheet iron, by leaving a space of about four inches all round between the sides of the lower vessel and the air tight box or case withinside.

Such are the improvements that have occurred to me.

CHAPTER VIII.

Miscellaneous information.

I AM indebted for the following remarks to the notes of *Dr. Bollman.*

June 24, 1810, Mr. Pollock showed me the works of the Gas Light Company. They are very extensive, and becoming daily more so, as the demand for the gas is greater than the company can supply. Several other companies are already forming. The opposition to this new mode of lighting was at first very great, arising chiefly from the interested alarms of oil dealers, tallow chandlers and others, who were employed in lighting streets and houses in the old way. These persons had interest enough to cause the gas lights to be discontinued in Pall-Mall, which was lighted up on the new plan by means of coal gas. But in this very street, the gas lights are about to be reinstated, at the request of the parish.

One chaldron of coal produces 10,000 cubic feet of gas.

One lamp burner consumes one cubic foot and a half per hour: and is supplied by the company at the rate of three guineas per annum, for a light equal to three candles of six in the pound.

The coke obtained, by good management will pay for the coals consumed in coking.

The wages of the attendants, and the fuel consumed in the furnaces, are about equal in value to a chaldron of coals.

One gas light, is equal to about three common lamp lights.

The retorts are cast iron cylinders, 10 feet long, 15 inches diameter, and hold 2½ bushels of coal.

The furnace doors are on one side; the retort doors on the other side of the mass of masonry which surrounds the retorts, furnaces, flues and pipes.

The gas of all the retorts passes into one common tube, which opens into a lime vessel with several compartments, connected, but separated from each other by pieces perforated with small holes, through which the gas is compelled to pass in order to multiply its points of contact with the lime water. By this means the gas becomes purified, and freed from carbonic, sulphereous, and other uncombustible and noxious vapours and airs which accompany the pure coal gas from the retort.

The purified gas passes into the gas-receiver. The one I saw holds 10,000 cubic feet; is about 40 feet by 18, and 15 feet high. It is a huge box of sheet iron, rivetted and tarred to make it tight. The open end is turned down, and the bottom upward; it stands thus inverted, in a reservoir of water of somewhat larger dimensions, so that the water fills it quite, and dislodges every particle of air from the inside; it is balanced by counter weights fixed to chains, which pass over pulleys fixed to the ceiling; these weights nearly, but not quite balance the gas-receiver, so that it easily ascends when the gas rises through the water and takes its place in the upper part of the inverted receiver. These balance-weights serve also to prevent an undue pressure upon the gas, which would be prejudicial.

As the weight of the receiver presses more and more upon the gas in proportion as the former rises out of the water, this gradually increasing weight is calculated and provided for by means of the supporting chains.

The conducting pipes issue from the upper part of the gasometer.

The retorts are filled every eight hours, which is the time required completely to convert the contained coal into coke.

The retort doors are iron lids fastened on by wedges, easily placed and displaced.

The pipes issue from the retorts above the doors, and rise out of the projecting part of the cylinders: this projection is about six inches beyond the brick-work.

The fire consumed in the furnaces, amounts to about one fourth of the contents of the retorts; but this greatly depends on management.

The burners are of various forms, that which imitates Argand's lamp is most approved.

The carburetted hydrogen gas from wood, is not so convenient as that from coal, and is much more difficult to purify. Among coal, there is great difference in this respect: the gas from cannel coal is the best.

Mr. Winsor would procure a model of about five feet square of the whole apparatus, with explanatory drawings, for 140 guineas. If the drawings alone would be wanted, they would be priced at 100 guineas.

The present company twice failed before they brought their apparatus to perfection, and conquered the difficulties of opposition.

The pipes are jointed, partly by flanges screwed together, and partly by other joints.

The expenses of gas illumination, including the interest of capital, wear and tear of machinery, cost of materials and attendance, will still allow light to be afforded at one half the cost of the usual method before gas lights were introduced; and the light supplied is in all respects preferable. But in England, mechanical skill, labour of attendants, coal, iron, lead, copper, are all comparatively cheap to what they would be in America.

A few hands are sufficient to attend a large establishment.

These establishments are so contrived, as to admit of being extended when the demand for gas increases.

The expense of apparatus, pipes, &c. necessary to illuminate one mile of street, will cost in England about 4000 guineas. The conveying pipes should be laid along the kerb stones, or under the gutter, and the lanterns placed on handsome perpendicular pillars, in the centre of which the gas pipe ascends to its burner. This arrangement also, would be convenient for shops and houses to take off the supply required.

All the pipes are of cast iron, excepting the very smallest, (which are of lead). Cast iron pipes also are in general use in London for conveying water.

The process of gas-distillation goes on at the works night and day.

There is so little pressure on the pipes that there is no apprehension of their becoming easily out of order.

The following is, with some slight alterations, the substance of information for which I am indebted to *Mr. S. A. Law*, of New York.

For a gas light apparatus that will produce 400 cubic feet of gas at each charge, that is, every 8 hours, the cylindrical retorts should be 5 feet long, and one foot diameter inside.

Dimensions. The main pipe that conveys the mixed vapour from the retort, should be 3 inches diameter, and communicate (if there is convenience for it) with a worm tub in a wooden reservoir of water, or flake stand. The gas-holder should not contain less than one thousand cubic feet, the pipe that conveys the gas from the gas-holder, may be $1\frac{1}{4}$ to $1\frac{1}{2}$ inch in diameter.

A retort 8 feet long by 16 inches diameter inside measure, will require four (upheaped) bushels of coals, and will produce from 800 to 1000 cubic feet of gas at one charge, worked off in eight hours. If the whole of the gas be not extricated at the end of 8 hours, which it generally is, a quantity of dense stinking vapour will puff out when the workmen open the retort to discharge the coke, or charred coal: (provision should be made to burn this at its exit, or permit it to escape up a high chimney, otherwise it may become offensive when the works are on a large scale.—T. C.)

One cubic foot of gas will supply for one hour a light equal to two candles of six in the pound. In England at present, dipt candles cost 12*d.* mould candles 13*d.* per lb.

A small apparatus for gas, sufficient to supply one hundred lights, is estimated at 600*l.* sterling.

Double sheet iron, used for gas-holders, weighs 100lbs. per seventy square feet.

Cast iron pipes cost 16*s.* sterling per cwt.

Coal 3*l.* sterling per chaldron of 36 bushels: weight of a chaldron about 29 cwt.

The coke produced by the coal distilled, amounts in value to from ½ to ⅔ of the value of the coal employed in the retorts.

Chandeliers, plain, calculated for two gas lights, cost 30*s.*: for one light 10*s.* 6*d.*- for a lamp 5*s.*

In a large way, for lighting streets, an apparatus that would supply 1000 burners, each giving light equal to six candles of 8 in the lb. and calculated to burn six hours in the winter nights, would require such an establishment as the following:

A dwelling-house for a superintendant; about 25 feet by 20 on the ground plan.

Two buildings, each about 20 feet square.

A yard about 30 feet square.

Lime vessel from 10 to 12 feet square.

21 retorts, each 8 feet by 16 inches, placed either in one line, or one above another, so the upper one may be fixed over the interstice between the two under ones; the fire circulating under and over them.

Beside these there will be wanting for such an establishment,

Two gas-holders, each containing 10,000 cubic feet, 2000*l.* sterling.

Purifying vessels will cost 200*l.*

Two miles of pipe (mains) to convey the gas; 6 to 7 inches diameter, 2000*l.*

The small communicating pipes which serve to convey the gas to private houses and shops, cost about 40*s.* per light; but the inhabitants pay this.

The annual expense of such an establishment may be thus calculated:

Retorts, - - - -	*l.* 300
550 chaldrons of coals for the gas, at 3*l.* -	1650
Coals for fuel, - - - -	450
5 mens' wages, - - -	350
Stationary, - - - -	50
Casks for tar, &c. - - -	50
Contingencies, - - - -	100
Superintendant's wages, - - -	
Clerk's wages, - - - -	
Rent of buildings, - - -	
Interest of money, - - - -	
Wear and tear, - - - -	

Annual income from such an establishment:

1000 lights at 4*l.* - - -	4000
Coke, 700 chaldrons, - - -	1400
10,000 gallons ammoniacal liquor, worth	205
Coal tar, worth as much, - -	205
	l. 5810

(Upon this calculation, it seems to me evident that 4*l.* per annum for the light of six candles, eight in the lb. is too little: and considering the (at present) uncertain expense of wear and tear, it ought not to be even in London, less than five pounds sterling.—T. C.)

The mains or cast iron pipes in the streets, are from 6 to 7 inches diameter inside. The ends are inserted tightly in flanges; they are cast in lengths of nine feet: the inside diameter of the shoulder is 8 inches when the pipe is 7 inches diameter; thickness of the iron $\frac{7}{8}$ of an inch at the ends with a rim an inch thick.

Where the pipes are joined, the small end of one is forced into the shoulder of the other; the pipes are then levelled, and the openings tightly caulked with rope-yarn. Then a long roll of stiff clay flattened a little, is put round the joint; a hole is made at the top, and melted lead is poured in till the vacancies are filled: then the clay is taken off, and with blunt stamping irons the lead is driven in just as caulking is done. After this the pipes become so joined that no gas can escape, and they may be covered with earth and pavement.

To lead the gas from a large pipe to a shop or lantern, bore a hole in the top of the pipe; cut a screw, and then screw in a crooked piece of pipe the size of a gun barrel. To this crooked piece, short pieces of gun barrels 2 feet long, may be joined by being screwed together, the end of one into the other, by a screw of an inch or inch and half long. Very small pipes again may be used to lead the gas to the lamp in the street or to a shop; from $\frac{3}{8}$ to $\frac{1}{2}$ an inch outside diameter.

The following notes are from another friend.

Coal Gas. 50 oz. of pit coal, in a red heat, gave 6 oz. of liquid matter, covered with empyreumatic oil, and 26 oz. of cinder or coke; (1805, by Mr. Northier, of Leeds; Monthly Mag. for April, 1805.) The fluid was acid, and contained at the bottom some tar. The retort was a refiner's crucible, with a metal cover, luted with clay: a tube was soldered into the cover, and bent to come into the pneumatic trough; the receiver had a stop-cock and small tube.

112lbs. Newcastle (bituminous) coal, produces from 300 to 360 cubic feet of gas, of which .5 of a cubic foot is equal to one tallow candle of six in the pound for one hour: wherein from 170 to 180 grains of tallow are consumed in one hour. Hence 20 cubic feet of gas is equal to one pound of candles, of six in the pound, burnt one after another.

A retort of 112lbs of coal, previously heated, will produce from two and a half to three cubic feet of gas in four hours from each pound of coal, provided the coals are not more than four inches deep. Six inches deep is a convenient depth.

For large works cast iron retorts are employed of seven or eight feet long, and one foot diameter, tapering down to ten inches. The gas must be produced by a bright cherry red heat.

Water absorbs $\frac{1}{27}$ of its bulk of the gas.

When burnt in a vessel of oxygen gas, over lime-water, we get water and carbonic acid gas.

A cubic cord of wood, equal to about 2¼ French metres, (a metre being little more than the English yard) yields 255 Paris pounds of charcoal, and 70 buckets of acid: furnishing 50,000 cubic feet of gas.

If not well washed in lime-water, or caustic alkali, it is apt to contain sulphur.

600 pounds of pit-coal evaporate ten cubic feet of water in 20 hours, and 430 pounds of coke evaporate 17 cubic feet in twelve hours and a half.

Lord Dundonald found that a quantity of coke, used in a lime-kiln, produced an equal quantity of lime in ⅓d of the time that coal would.

1000 pounds of coal tar produces 460 to 480 pounds of pitch.

1 chaldron of coal, from 25 to 28cwt. produces from 1¼th to 1½ chaldron coke: from 150 to 180 pounds of tar, at ten pounds the gallon: from 220 to 240 pounds, or 22 to 24 gallons of ammoniacal liquor, and about 10,500 cubical feet of gas: 36 bushels to the chaldron. Used to stop cracks and apertures in the iron: Cement sal. amm. 2 parts: sulph. 1 part: iron filings, 16 parts: rub the materials in a mortar, and keep them dry. When wanted for use, grind 1 part of this composition with 20 parts of iron filings.

COST OF MATERIALS IN LONDON.

Sheet iron pipe, brazed, ¼th inch, 4*d.* per foot: ½ inch, 5*d.* 1 inch 7½*d.*

Copper about the same.

Cast iron retorts, 15*s.* 6*d.* per cwt.

Cast iron door frames, 20*s.* do.

Furnace bars, 10*s.* do.

Sheet iron, No. 23, 24*s.* do.

Gasometer chains, 5*d.* per pound.

Nuts, screws, &c. 6*d.* to 7*d.* per pound.
English bar iron, 13*l.* per ton to 18*l.*

The prices according to Accum are as follows:

Estimate of the price of a Gas Light Apparatus, if erected in London, capable of affording, every twenty-four hours, light equal to forty thousand tallow candles, six in the pound, burning one hour.

	l.	*s.*
Gasometer, to contain 10,000 cubic feet of gas .	236	0
Wheel-work, regulating chain, balance-work for ditto, with wooden framing	160	11
Wrought iron cistern for gasometer—36 feet wide, 24 feet long, and 16 feet deep	500	0
(*It would weigh about sixteen tons.*)		
Wooden framing built around it, to secure ditto. .	150	0
Condenser, cistern, and communicating pipes .	126	0
Lime machine, made of cast iron plates	82	0
Gasometer house, built of frame work, and weather-boarded	250	0
Twenty-four retorts set in brick-work, with furnaces for ditto, complete	336	0
Sundries	100	0
	1940	11

A gas light apparatus, complete for work, capable of affording every twenty-four hours a quantity of light equal to 1,400 Argand lamps, each lamp equal in intensity to six candles, six in the pound, burning for five hours, will cost 3,500*l.* if erected in this metropolis.

London Price List of the most essential articles employed in the erection of a Gas Light Apparatus.

SHEET IRON PIPES BRAZED.

¼ inch in diameter	0	4 a foot	in 15 to 18 feet lengths.
⅜ ditto	0	4 ditto	
½ ditto	0	5 ditto	
⅝ ditto	0	6 ditto	
¾ ditto	0	6¾ ditto	
⅞ ditto		7 ditto	
1 inch, ditto	0	7½ ditto	
1⅛ ditto	0	8½ ditto	
1¼ ditto	0	9 ditto	
1⅜ ditto	0	10½ ditto	
1¾ ditto	0	11 ditto	
2 inch, ditto	1	1½ ditto	
2¼ ditto	1	4 ditto	
2½ ditto	1	5 ditto	
3 inch, ditto	1	6½ ditto	
Copper pipes brazed ¼ inch	0	4 per foot	
Ditto, ditto, ditto ½	0	5½ ditto	

Gas light cock's-spur burners with stop-cock 2*s*. 6*d*. to 3*s*. 6*d*.

Argand lamps, with glass-holders, from 3*s*. to 4*s*. 6*d*.

Cast iron retorts, weighing 7cwt. at 15*s*. 6*d*. per cwt.	*l* 5	8	6
Mouth-piece for ditto, complete	1	14	8
Cast iron door frames for retort furnace	1	0	0

Furnace bars, 10*s*. per cwt.

Sheet iron for gasometer, (No. 23) 24*s*. per cwt.

Gasometer chains, 5*d*. per lb.

Balance weights [Plates] for gasometer, 9*l*. 10*s*. per ton.

Cast iron cistern plates

——————smaller size for lime machine, 18*l*. per ton.

——————middling size for tar cistern, 16*l*. ditto.

——————largest size for gasometer cistern, 14*l*. ditto.

Cast iron flanch pipes, 2-inch diam. at 5*s*. pr. yd. in 6 feet lengths.

ditto	3	ditto	6	ditto	6	ditto
ditto	4	ditto	8 6	ditto	9	ditto
ditto	5	ditto	10	ditto	9	ditto
ditto	6	ditto	12	ditto	9	ditto
ditto	7	ditto	13 6	ditto	9	ditto
ditto	8	11*l*. 5*s*. per ton.			9	ditto
ditto	9					
ditto	10					
ditto	11					

1/8 inch nuts, screws and washers, to put iron pipes together,	7d. per lb.
1/8 ditto	6 ditto
1/4 ditto	6 ditto
English bar iron	13*l.* pr. ton.
Best ditto.	18 ditto

Extract of a letter from M. Parmantier to Major Lacarriere Latour.

Sir—You have requested that I would furnish what I know respecting the discovery of the carburetted hydrogen gas employed as a means of lighting.

In the year 1797 I returned from the army to Paris on furlough, with M. Villiac, an officer of the corps of engineers. I was invited by him to an interview with M. Le Bon, to assist at some of his experiments on what has since been termed the gas light. I witnessed these experiments with so much satisfaction, that M. Le Bon being desirous of an eligible situation for the display of his discovery, I offered him my house in the Fauxbourg Poissouiere: yet this did not take place, because I could not persuade my family that there was not the least danger for the buildings; but shortly after I saw the passage Ratzivile illuminated by the said gas, in an apparatus called the thermolampe of Le Bon: the passage L'Orme was illuminated by the same means.

Several memoirs have been read in my presence by M. Le Bon, before a committee of the Philotecnique Society, and of the Athene of Arts, on the same subject. Nobody then thought to rob Le Bon of his brilliant discovery. O'Reilly, the editor of the Annales of

Arts, published in 1800, asserts that he knew as yet of no useful application of that *honourable discovery.* O'Reilly, although a true lover of the arts, was however, actuated a little by revenge against the artist, who had refused him some communication that he was anxious to reserve; still O'Reilly did not hesitate to acknowledge Le Bon as the discoverer of the gas light: of late the British have pretended to be the discoverers of the gas light, or at least the applicators to useful purposes of the gas light.

I understand Dr. Kugler has taken out a patent for the use of pitch as a material to furnish carburetted hydrogen. The procuring this gas from pine knots in Canada, and from the sawdust of the pitch pine, and the yellow pine, as I have for these four years past, is so similar to the procuring it from pitch, that I should greatly doubt if any patent would be valid for the exclusive use of this last substance; but the following patent, taken out June 13, 1815, by John Taylor, of Stratford, in Essex, puts the question out of all doubt here, though I do not consider his patent as good there. "He has invented an apparatus for the purpose of producing an inflammable air, or olefiant gas, fit for yielding light of great brilliancy, and free from any disagreeable smell from any kind of animal, vegetable, *or mineral oil, fat, bitumen, or resin,* which can be rendered fluid by heat or otherwise." The description may be found in the Monthly Magazine for February, 1816, and the drawings are given in the Repertory of Arts.

CONTENTS.

This book should be returned to the Library on or before the last date stamped below.

A fine of five cents a day is incurred by retaining it beyond the specified time.

Please return promptly.

Eng 2618.16
Some information concerning gas lig
Cabot Science 004243167
3 2044 091 984 864